THE SANITATION OF DOMESTIC BUILDINGS

F. LATHAM.

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WITH INTRODUCTION BY

BALDWIN LATHAM, C.E.,

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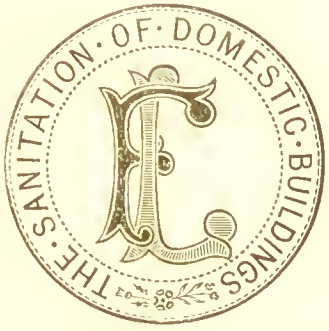

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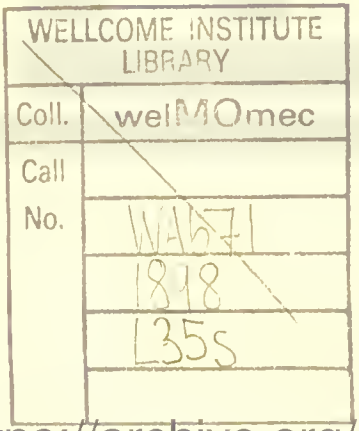

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PREFACE.

I HAVE read the work entitled "Sanitation of Domestic Buildings," which has been written by my nephew, and I can confidently recommend its perusal to all Sanitary Officers and others interested in domestic sanitation.

The author has had unusual facilities for acquiring sanitary knowledge both in theory and practice, and has quite recently taken part in the carrying out of the extensive sanitary works which have been inaugurated at Margate in connection with the complete sewerage and sewage disposal of that place, and also in connection with the improved sanitation of many thousands of houses which have been connected with the sewers of Margate.

At the present day it would be idle to suppose that many persons can be found to dispute the necessity of making our houses sanitary, and that for this purpose it is essential that those residing therein should be supplied with pure air and pure water.

It has not unfrequently happened that the imperfect drainage and water supply of a single country house has been the means of creating and spreading an epidemic of enteric or typhoid fever

within a large population, due to the drains having leaked into a loeal well, and the water of that well having been used, as it has been said, for dairy purposes. It is essential, therefore, that all detaehed houses whieh have to dispose of their drainage, on the one hand, and to seeure a pure water supply, on the other hand, should reeeive the most eareful eonsideration at the hands of the sanitary expert.

It is also equally important that the drainage and water supply arrangements within every town house should be closely eonsidered, so as to avoid on the one hand, the pollution of the water supply, and, on the other hand, the securing of a healthy habitation; and although mueh attention has been given to the testing of drains, yet we must always be mindful of the faet that however perfeet the eonstruetion may be at one period, there are forces at work within the drains themselves which, sooner or later, may render even the most perfect system of drainage inoperative and a source of danger. I allude especially to the eonstant ehanges of temperature taking place in house drains, whieh have a most material effect in destroying their water-tightness in a very limited period. It is no unusual thing in a house drain to have at one time melting snow passing through it, and at another period waste boiling water used for culinary purposes, or they may have a difference of temperature within a very limited period of not less than 180 deg. Fah. So great is this influence of temperature, that in an iron pipe 100 yards

long, uniformly heated, the difference of temperature between 212 deg. and 32 deg. Fah. would cause more than one joint to be completely drawn in that length. In the case of earthenware pipes the difference of expansion and contraction is not so great as in the case of iron, but the material is much more liable to failure by cracking and breaking than iron under similar conditions. The repeated contraction and expansion that take place in house drains may soon make what was once a perfect work a source of danger, and drains once air and water-tight, may leak both sewage and foul air. It is therefore imperative that all systems of house drainage connected with a system of public sewers should be so arranged that the foul air of the main sewer should be effectually cut off by a proper intercepting trap, and that the general arrangements should be such as to allow only the local air to pass through the house drains. Every system of house drainage should be subject to repeated examination from time to time to ascertain whether or not the drains still continue to be in good order. By such arrangements, which are contemplated by the author of this little book, the drains may be readily tested at any time, so that it may be known whether they are water and air-tight.

To all persons who value their health there is no doubt that such a book, which can be readily studied, will be of very great use, as they may easily be able to compare the system of drainage which may be in operation in their own residences

with what ought to be in use with a proper system of sanitation.

Often the inspection of a house as to its sanitary state only takes place after disease and, probably, death have taken place. As prevention is better than cure, the information given in the following pages, it is hoped, will lead to more attention being paid to the sanitation of domestic dwellings, and it will, if properly studied and acted upon, undoubtedly be the means of preventing much undue suffering and expense, as it can be clearly proved that there is nothing more expensive than disease and death.

BALDWIN LATHAM.

13, *Victoria Street, Westminster,*
17*th August*, 1898.

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The Sanitation of Domestic Buildings.

CHAPTER I.

Introduction.

The subject of house drainage is one which demands a greater amount of serious attention than is ordinarily paid to it, this neglect being in many cases the product of ignorance regarding the methods of modern sanitation, and in some instances the result of less excusable influences. That the diseases caused by sewer air and communicated through defective house drains are constantly with us cannot be denied. This condition of things could be ameliorated, if not entirely prevented, and the death-rate reduced, if more earnest thought were given to it; and it is the object of these articles to throw some light upon this important truth, with the hope that it may be of some practical help to those whose health and happiness is bound up in this vital question. Some people are apt to evade sanitary precautions, or to attach but little importance to them, whilst others are actuated by motives of false economy, and in cases such as these, it is only by a fortunate chance that no bad effect issues. When persons are, however, made aware of their negligence it is often

too late to prevent the disease and suffering which ensue. The writer has such an instance of neglect and its result before him, where a gentleman occupied a house for some time. Towards the end of his term, he and his family suffered from illness eventuating in death, which was attributed to the condition of the house drains. An Inspector was sent to examine and report upon the state of these, but was refused admittance, and only some slight exterior reparation was done in connection therewith. His successor, being more enlightened in sanitary matters, before entering upon his residence in the house caused a thorough examination of its sanitary condition to be made, when it was found that the drain, which passed beneath the floor, was without proper joints, the pipes being occasionally some inches apart, several barrow loads of black, rank, sewage having accumulated beneath the floor.

The foregoing is too often typical of the worst form of ignorance and neglect of sanitation; but there are many other cases of a less glaring character which have been the cause of much disease, misery, and loss, emphasising the fact that the necessity for good sanitation is shared in and demanded by the whole community, the neglect of it, although it may be only an individual instance, endangering a wide area — either directly or indirectly—by its alarming and deadly results. A water supply contaminated through leaky drains, or imperfect condition of sanitary apparatus, may be distributed throughout a district with fatal

effects, whilst the most dreaded and infectious diseases may be traced to bad drains, the germs of disease being contained in and conveyed by the escaping drain air. In many old houses, where the drainage has not been modernised, it is frequently the rule to find their condition unsanitary. Cases have come under the author's notice where the cesspool has, or cesspools have, been found beneath the kitchen floor, these having no proper ventilation. The yard of a house will perhaps be undermined with cesspools, the owners following the custom of emptying the contents of the old into a newly-dug one, these overflowing the one into the other, old wells being not infrequently utilised for such purposes. The cesspool and well are sometimes discovered side by side, the steining (when it exists) of the latter bearing distinct greasy marks of sewage percolation. The closets and other domestic arrangements are often placed under the staircase and other unsuitable corners, whence they ventilate into the house.

The position of storage cisterns in many houses permits of no proper access for cleansing and inspection purposes, the cisterns themselves being without suitable covering, and not effectually cut off from communication with the drains. In some cases, where it is readily accessible from the bedrooms, servants may, if the cistern be not covered and locked, dip and wash filthy articles in the water. These are, then, some of the defects which frequently exist in old houses, and it is even far from rare in houses of recent date for such arrangements to be

found, some being still so constructed when opportunity offers.

Amongst the defects commonly met with of an undoubtedly injurious and dangerous character, may be enumerated leaky drains; drains with insufficient or varying falls, and with no provision for inspection and access for cleansing; defective and insufficient traps and gullies; the use of the filthy D trap, flimsy soil pipes, perhaps inside the house, and unventilated, except through the joints; rain-water down pipes used as ventilators, perhaps unjointed and situated near windows, or terminating under eaves of roof, and near storage water cisterns; waste pipes from sinks, with only a useless bell trap; openings of drains in floors for washing down purposes acting as ventilators; unsanitary closets; ventilation pipes taken into chimney flues, and other arrangements permitting the escape of poisonous effluvia.

Dr. Thorne Thorne, C.B, shows in his exhaustive report dealing with typhoid and diphtheria, that the decline of typhoid fever death-rate has gone hand in hand with improvements in sanitation, it being about 0·38 per 1000 in the seventies, and has gradually fallen to 0·17, or less than half. Typical cases of fever outbreaks from imperfect sanitation are given by Dr. Chaumont, and Dr. Garrett, of Cheltenham, and others. The author has had several such cases of typhoid and diphtheria come under his notice, and upon investigation, nearly every case could be traced directly or indirectly to bad and defective sanitary arrangements; and it has invariably

happened that upon prompt attention, and defects being remedied, the spread of disease has been checked, delay in such cases ensuring its further spread. One instance strongly suggests itself. A case of typhoid took place in a house, and a child, living in another part of the house, soon after contracted the disease. This case the author investigated, discovering that the house was drained into a cesspool nearly filled up; the ventilation pipe—flimsy and defective—in connection with the cesspool being fixed against the house wall close to the window reveal of the room where the second case took place. The house was practically a new one, but in fixing the ventilation pipe in question one of the cast iron lugs projected in front of the window of this room, and this lug had been removed by a blow, taking with it a piece of the back of the flimsy pipe, making a large open fracture, partly obscured from sight, and on a level with the window of the room. It was by the smoke test that the fault was discovered, the smoke escaping in such quantities from this fracture as to blacken the brickwork reveal and window sash, and proving that the gas and impure air passing off from the cesspool in this manner escaped and found its way through the window into the interior.

Another case of a similar character was where two children died from diphtheria, which was traced to a communication between a filthy privy pit and the underneath of the floor of a house by a network of rat runs. The work of house drainage undertaken and carried out by many

builders is too often considered by them as a secondary matter requiring little attention, and the fact that some of the principal parts when completed are hidden under ground and floors, or behind casings, gives opportunity for concealing much bad work. In order that houses should be healthy dwellings the drainage must be perfect, and where this work has been satisfactorily executed, it remains the duty of the occupiers to exercise cleanliness. To ensure that all drains should be above suspicion, good workmanship on the very best principles must be insisted upon, whilst those engaged on the work should be under the direction and control of competent and reliable authority.

If a town is sewered by a defective system, it is no reason or excuse that house drains connected therewith should not be of the best, for house drains in connection with bad sewers or cesspools have the greater need of perfection to keep back offensive effluvia and germs of disease—present in cesspools and defective sewers—from penetrating the dwellings, contaminating the air, and attacking the inmates. It is a mistake to think that because once house drains are made perfect they will remain so for an indefinite number of years. They should be periodically tested with a view of ascertaining whether any faults in their action or construction exist, such as fracture caused by frost, settlement, or undue pressure, or jar; trap bottom knocked through, or water-closet cistern out of order, and so giving insufficient flush to cleanse the drains. All of these accidents are possible, and although the

fault may be small, its result may be serious unless rectified. Occupiers of houses should pay continual attention to the drains being kept clean and in order by proper flushing, and the occasional use of hot water with soda and disinfectants. Care should be taken to remove, by means of a proper bucket provided in connection with sink trap, any grease that may have been collected therein from the scullery sink waste, or by the use of a special flushing rim trap automatically removing the grease; and by further keeping the various gully traps under rain-water pipes, and in yards for surface water, &c., well cleansed and charged with water above the sealing line, more especially in hot and dry weather.

CHAPTER II.

Section 1.—Drains.

Drains are combinations of tubes or pipes, placed in convenient and practical positions, jointed together in such manner as to form water and gas-tight conduits for the purpose of conveying all waste liquids and fæcal matters from our dwellings into a sewer or other suitably constructed receptacle. With house drains the selection of pipes is the first and not the least important matter. This requires a great deal of experience, as there are many points to be observed and considered.

The pipes considered most suitable for house drainage purposes are manufactured from clay, and in the firing are glazed with salt, being known as salt-glazed stoneware pipes.

Stoneware pipes should be well baked, of hard substance, and quite straight, truly concentric in section and of equal thickness throughout, not less than one-twelfth the diameter, and thoroughly glazed both inside and outside. They should be perfectly non-porous, the inside smooth, and free from irregularities. The outside of spigot end should be slightly roughed in the making, to afford a good key to the cement, and the socket should be of sufficient depth to make a good joint, the inside of which being also roughed in the making. The pipe and socket should be made in one piece. The tested pipes manufactured by Messrs. Doulton

are known as the standard of what good pipes should be.

Beside Messrs. Doulton and Co., there are other firms recognised as successful manufacturers of stoneware pipes. The Albion Clay Company, Ltd., manufacture the well-known "Granitic" stoneware pipes, which are carefully made and of first-rate quality. These pipes are extremely tough and hard to fracture, and at the same time non-absorbent. The selected pipes, which are stamped "Tested," are very satisfactory for the best class of work, beside being reasonable in cost. Messrs. Craig, Limited, is an old-established firm, and amongst their numerous fire-clay works for which high awards have been given, their glazed drain pipes have received a favourable notice for quality, good shape, and glazing. Their best selected are all that is required. Messrs. Jennings' stoneware pipes, judging from the large amount of work executed in this line by the firm all over the country with the most favourable results, is sufficient proof of the excellency of their manufacture. Messrs. Oates Green, Limited, manufacturers of the "Nalethrie" stoneware, are noted for their "Truinvert" patent pipe, and stand high for the excellency of their materials and workmanship. Messrs. Sankey and Son are the manufacturers of various descriptions of stoneware goods, and, like Messrs. Doulton, have London and country-made pipes. Their productions are invariably of a good sound and impervious nature. There are other firms in various parts of the country who stand

equally as high for the excellence of their ware as the foregoing.

Where a drain passes under a house—a method which should be avoided where possible—it is desirable, but not absolutely necessary, to use iron pipes jointed with lead.

A special advantage gained in the use of iron pipes for this purpose is that, being in 9ft. lengths, they only necessitate one joint in a length where stoneware would require four, besides which they are more self-carrying, and not so liable to fracture as stoneware. These pipes should be vertically cast with sockets downwards. They should be truly shaped concentric, and the thickness of metal maintained without variation throughout.

The spigot end of each pipe should be furnished with a projecting bead or fillet, which should fit into the sockets, leaving not more than $\frac{1}{16}$in. clearance all round. Iron pipes for sewage purposes of diameters of 4in., 6in., and 9in., should be 9ft. in length, excluding sockets, and $\frac{3}{8}$in. in thickness for 4in. and 6in. pipes, and $\frac{5}{8}$in. for 9in. pipes. The depth of the sockets should be $2\frac{3}{4}$in., and the weight 160 lb., 236 lb., and 560 lb. each respectively. They should stand a test of between 400ft. and 500ft. of water. The metal used in their manufacture should be free from cinder or inferior iron, and be strong, tough, and close grained. They should be free from air holes or other imperfections of casting. Iron pipes are sometimes treated with a special process to prevent corrosion from the action of the sewage.

The process known as the Barff is useful for this purpose, and consists of covering the surfaces with a coating of magnetic oxide. It is produced by tho action of superheated steam upon the metal when confined in a heated chamber, the coating of oxide being deposited on the surfaces of the pipes by the combustion of the decomposed steam and oxygen. This system has been improved upon to a great extent by a less expensive treatment, known as the Bower process, which is similar to the former, but the magnetic oxide coating is obtained in a quicker and somewhat different manner. Dr. Angus Smith's process, which is another treatment for iron pipes, for the prevention of corrosion, is by heating the pipes to a high temperature and placing them vertically into a heated liquid mixture of coal tar, pitch, resin, and linseed oil, the pipes after immersion being slowly withdrawn and placed in their same upright positions to cool. Before being subjected to this treatment they arc well cleaned and freed from any cinder or rust. Having thus given a description of the pipes generally used for house drainage, the next important matter for consideration is the manner of laying them to constitute a clean and effective drain.

Drains should be laid with gradual falls in the same direction from beginning to end. Perfectly straight pipes having been selected, so that they will efficiently drain themselves dry and leave nothing in any hollows to lead to decomposition and foulness, the trench should be excavated a width convenient for working, and the floor

finished to the required fall, starting from the sewer end, and should there be any soft place, or where too much has been removed, the filling in should be well consolidated, or concrete substituted for the original material. A length of pipes should be laid in their places with the spigots turned in the direction of the flow of the drain before any joints are made, but in the case of ordinary socket pipes a strand or two of tarred gasket or hemp should be tightly fastened round the end of the spigot of sufficient thickness to firmly hold the same in the socket of the next pipe, but which at the same time must not occupy much of the depth of the socket which is required for cementing, When the pipes are being so laid, small countersinkings or grips should be cut in the trench just deep enough to receive the sockets, in order that the barrels may rest firmly throughout their length on the solid floor of the trench, thus relieving the sockets from undue pressure, probably resulting in the breakage of the pipes and joints for want of uniform support in the direction of their length. It is always necessary where the pipes do not rest on the firm virgin earth to lay a bed of 6in. of Portland cement concrete throughout the length and width of the trench for the drain to rest upon. This can be done before the drain is laid, in which case, when the joints are finished, the space underneath the pipes between the sockets should be well filled up with good fine cement concrete. Sewers and drains up to as recent date as 1845 were as a rule constructed of brickwork, sometimes as circular,

and sometimes as square conduits, and the workmanship and materials in connection with them were generally not of the best.

At the introduction of earthenware pipes for sewage purposes, and for some time afterwards the collars or sockets were made by a separate process and placed on them by hand until a method was introduced by which pipes and sockets were manufactured in one piece. For some time the joints were merely made with clay, which very soon washed out. Sound water-tight jointing was not considered of much moment, until its necessity was recognised. At the present time, when nothing but such joints can be permitted, Portland cement for stoneware pipes meets with general approval as an all-round good material sufficient for most cases.

The method of cementing the joints of ordinary socketed stoneware pipes is very important, and is done, in the first place by well caulking the joint underneath, between the socket and spigot, with Portland cement, previously pushing the spigot and gasket well home into the socket.

After the underneath part is filled in, the sides, and lastly the top, should be completed, and at the finish the whole should be trowelled off to a smooth surface. To make sure that any cement which may have gained access to the inside of the pipes is properly removed, a leather disc on the end of a rod, of a loose fit, should be passed through the interior to remove such intruding substance, which otherwise might obstruct the drain.

A variety of joints have been patented, and there

is, as a rule, little or no fault to find with them, some of those recognised as successful being as follows:—

Fitzpatrick's patent joint is made as an improvement on the ordinary method of jointing pipes, and to dispense with the use of gasket, which in the usual joints is first placed between the spigot and socket, for the purpose of securing a uniform level in the pipes and preventing the cement entering and causing an obstruction. This joint is made by bevelling off the end of the spigot, a corresponding bevel and shoulder being formed at the back of the socket, giving a perfect continuity of bore, without the use of gasket. The joint is then finished in cement, and the liability of any of the material finding its way into the inside of the drain is reduced to a minimum. (Fig. 1.)

Hassall's "Double-lined" joint has a composite material cast on the spigot and socket; when the pipes are pushed together grout cement is run into an opening provided in the socket for that

Fitzpatrick's Joint

Fig. 1.

purpose. The grout cement then runs all round a groove left between spigot and socket, and makes a tight joint. (Fig. 2.) Sykes' patent is a joint manufactured by the Albion Clay Company, Ltd., and is on the principle of a screw which is cast on the spigot and in the socket in composite, and when well tightened together cement can be used in the space remaining to further secure the joint. (Fig. 3.) Green's patent "Truinvert" pipe is a joint on the Hassall system, and when properly made affords an unusually safe and strong joint

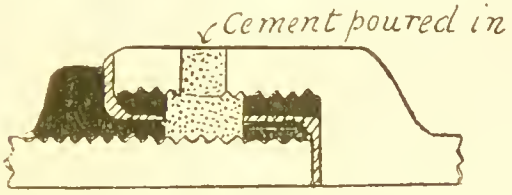


Fig. 2.

for house drainage purposes. It is formed, in the first place, by a lengthened double socket, one socket being deeper than the other, for the reception of the Hassall or composite joint, while the other forms a rest or seating for the end of the spigot. The pipes being thus placed together, a chamber is left between the composite and the end of the first socket for cement or other grout, which is admitted through two holes at the top of the socket.

Self-adjusting joints, although not so extensively used for house drainage, are invaluable in some cases, and almost indispensable for laying drains

lead are sometimes used in preference to gasket, but as hot lead is liable to melt these rings, the method is not to be recommended. Melted lead is then run in and the whole caulked up, and at the finish the joint should be full of lead. Great care should be taken that no lead gains access into the interior of the pipes. The melted lead is run into the joints of small pipes by means of a fillet of clay being formed between the end of the collar of the one pipe and the barrel of the other, leaving the cavity between the spigot and socket free for the lead to

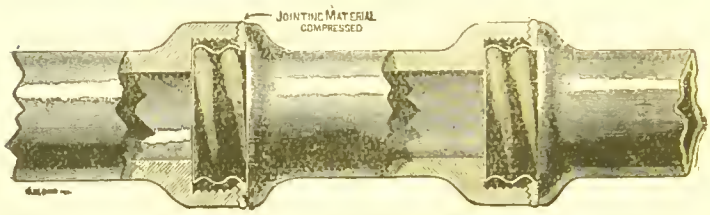


Fig. 3.

run round. For large pipes, in the place of the fillet of clay, which would not stand in making a large joint, gasket is twisted together, and after being dipped in puddled clay is fastened tightly round the pipe, and pushed against the collar to form a fillet, as in the former case.

The cement used for drainage works should be of the best Portland, finely ground, and weighing 112 lb. to the struck bushel, breaking with a weight of not less than 250 lb. per square inch after seven days' immersion in water. All cement for drain joints should be mixed up and allowed to stand awhile before use. If not so treated the

cement is likely to blow. At the same time it should not be worked up a second time. In practice, it will be found that the addition of a small quantity of clean, sharp sand, used with discretion with the cement is beneficial, as the joints are not so likely to crack as when made with neat cement. The writer has had cases where, after drains have been satisfactorily laid,

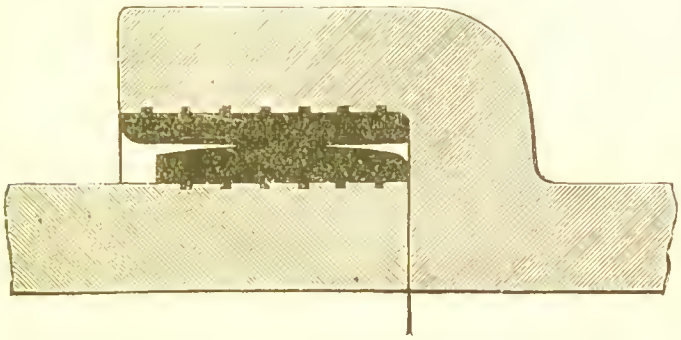


Fig. 5.

the joints on becoming set have blown and cracked owing to the heat of the cement, and thus rendering the drain defective.

Concrete for drainage works should be composed of one part Portland cement well mixed while dry with six parts of good, sharp, clean gravel, or Thames ballast, the stones not to be larger any way than will pass through a 2in. ring, and to have a proportion of sand or fine gravel which will only just fill in the interstices of the large materials.

Often it is found necessary to carry a drain over

an old filled-up cesspool of which the crown has been removed; unless proper precautions are taken, upon the ground subsiding the drain will be fractured. To prevent this it should be carried over the treacherous spot either by replacing the crown at the level required, or by bridging with a strong stone flag or iron girder with good bearings on each side. If possible, however, it is better to avoid such treacherous spots. The method of

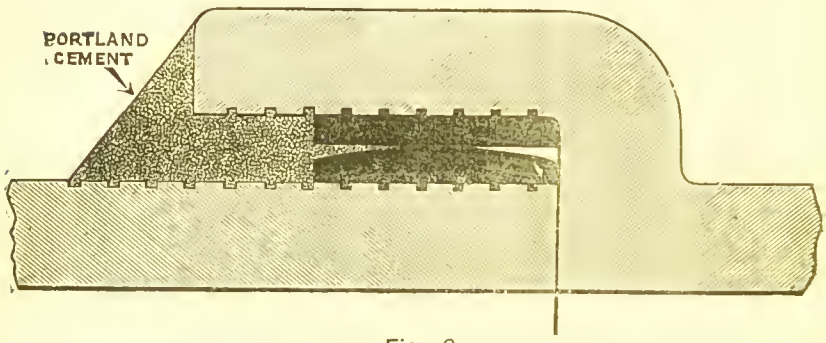


Fig. 6.

laying drains embedded with concrete is somewhat the same as already described. On the floor of the trench 6in. of good concrete should be laid, about 18in. in width. The pipes are then laid before the concrete becomes set, and the sockets sunk till the barrels rest firmly on the bed. The joints are then made in the same manner as before, and allowed to set, and, after testing any space between the pipes and concrete floor, which had been necessarily removed for jointing purposes, it should be carefully filled in with concrete,

which should then be brought round 6in. in thickness till the drain is perfectly surrounded. When this operation is completed it is advisable to again test the drain, in order to be assured that no fracture of either joints or pipes has taken place.

When the drain is more than 10ft. in the ground, special provision should be made against the crushing of the stoneware pipes by compression from the superincumbent material. This can be done by using pipes made for the purpose, which are stronger than ordinary ones, being one-tenth the diameter in thickness. Should pipes of ordinary thickness be used they should have an extra support by being laid in a bed of concrete brought half way up the sides, and in some cases surrounded with this material. It should be borne in mind that drains under houses should be laid in perfectly straight and direct lines, and with uniform falls from one end to the other. Thus assuming the pipes to be faultless and joints carefully made, the tube will be true and free from those defects which might tend to check the free flow of its contents, and thus safeguard against stoppages or fouling. As a matter of fact, all drains, including those outside of houses, should be laid in as straight and direct lines as practicable. With regard to the fall of house drains, it is advisable to have an inclination that will give a self-cleansing velocity to the sewage of 4ft. per second. A fall of 1 in 70 to a 6in. drain, and of 1 in 50 to a 4in. drain, will effect this, when running full or half full. It is true that a less fall is sometimes given, even up to 1 in 120

for 6in., and 1 in 80 for 4in. drains, giving a velocity of 3ft. per second, which by some authorities is considered sufficient, but the sharper fall is preferable, and lends itself better to ventilation purposes.

The determining the size of the pipe for house drains requires some consideration, there being as much hazard in making it too large as too small. Four-inch pipes should be the minimum size used, and it is quite sufficient to drain any fairly-sized house; they would scarcely ever run full, and are much more self-cleansing, and less likely to block than 6in. with the same quantity of sewage passing through. A drain running half-full bore is less likely to become blocked than one running less than half-full. This is owing to the fact that the deeper the water runs in a drain the quicker is its velocity, and quicker velocity means greater cleansing effect. The sectional area of a 4in. pipe is less than half that of a 6in., and therefore a 6in. drain would hold more than double that of a 4in. of the same length. A 6in. drain with a fall of 1 in 70 when running half full is capable of discharging 150 gallons of sewage in one minute, and with a fall of 1 in 120, 115 gallons. A 4in. drain with a fall of 1 in 50 will discharge 65 gallons per minute when running half full, and 50 gallons per minute with a fall of 1 in 80. When running full the discharge would be double. From the foregoing it will be seen that a 4in. pipe is more self-cleansing for ordinary houses than a 6in., besides not offering so much space for the collection of drain air or gas, nor surfaces for the

deposit of filth to foul the drain. Drains 6in. in diameter should only be adopted under special circumstances for large establishments.

In order to set out the fall of a drain, the mason's spirit level and long straight edge are, as a rule, used. The spirit level should be placed on the straight edge, and this being laid on the top of the sockets of the pipes it should be raised at the lower end till horizontal. Then the measurement between the lower side of the straight edge and top of socket of pipe will represent the fall, and the length from the socket on which the other end of the rod rests to this point will represent the distance, and the one divided into the other will give the inclination. A convenient way is to fix a small cube of wood representing the fall required in a given length to the lower end of the straight edge. It is a mistake to merely lay the level on the barrel of the pipes, which is often done to obtain approximate falls without using a straight edge, as no uniformity of inclination can thereby be obtained.

Section 2.

Junctions with drains should always be at oblique angles. The Model Bye-laws of the Local Government Board make a special note on this matter to the effect that "Tributary drains, whether vertical or horizontal, ought always to be formed with proper bends, delivering in the direction of the flow and at the side of the drain into which they discharge." (Fig. 7.)

This is necessary to prevent the interruption of the flow in the drain by a cross current, which would cause a deposit, probably eventuating in a stoppage. (Fig. 8.) In laying drains provisions should be made to give all junctions and bends an extra fall. A tributary drain should always be connected to a junction arm of the same

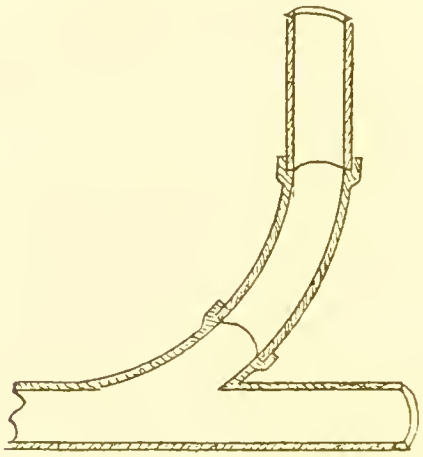


Fig. 7.

size; thus a 4in. branch drain should not be made to fit into a 6in. junction arm, and so on. All junctions should be made slightly above the level of the invert in the case of house drains, and not, as is sometimes done, brought in at the top. It is often the case that when a drain passes close beside a gully, &c., for the pipes to be brought straight down and the junctions made in the top of the drain. This is a pernicious

practice, and one to be condemned. Slow bends in connection with proper junction pipes should be used.

The junction of house drains with existing sewers

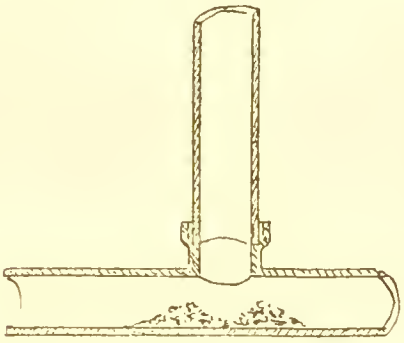


Fig. 8.

should be by proper bends, the same as in the case of drains and the practice of knocking a hole in the side or top of the sewer, and simply thrusting the end of the house drain into it and making good with

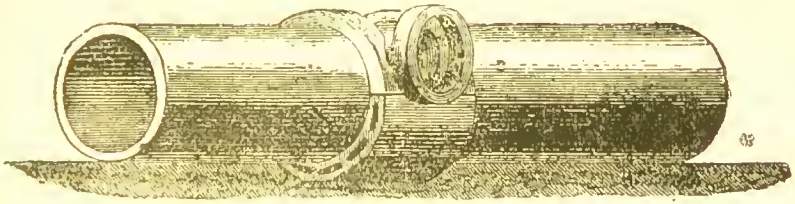


Fig. 9.

cement, should be a thing of the past and abandoned for the future. These connections should be executed with saddle pieces. (Figs. 9 and 10.)

Connections with brick sewers should be made by means of proper junction blocks specially manufactured for the purpose, care being taken that these are not turned in the wrong direction, as is not infrequently the case. (Figs. 11 and 12.)

Fig. 9.

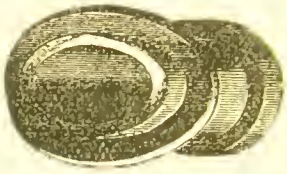


Fig. 10.

With existing iron sewers junctions should be made by boring the pipes to the size required, and proper connections made with saddle pieces.

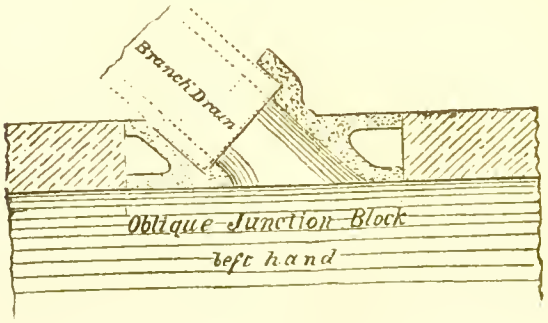


Fig. 11.

When it is necessary to have bends in drains, easy curves should be used, which can always be obtained, made in the same material as the pipes. (Fig. 13.) It is a gross mistake to form curves with straight pipes (Fig. 14) a method which is

too often followed by some who know no better. The results in such cases are, that proper joints cannot be made owing to one side of the spigot being drawn nearly out of its socket in producing the required angle, while the other more or less closes up the cavity required for the cement joint, and thus only the top and bottom of the drain are able to be jointed, while the two sides are imperfect, and at the same time impeding the flow.

Junction Block.

Fig. 12.

When it is necessary to enlarge small drains in their course, taper pipes should be used, which are made, for instance, with a 4in. socket, and the pipe

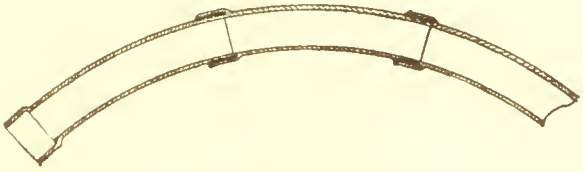


Fig. 13.

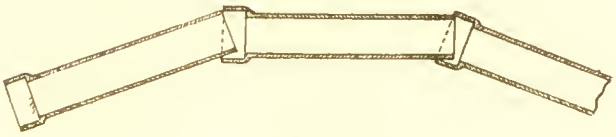


Fig. 14.

or barrel gradually enlarged to 6in., and so on, so that a drain can be enlarged at any required point without any unevenness or projection in the interior. The usual form of taper pipe is, however

incorrect; for instance, a taper enlarging a 4in. into a 6in. should be so formed as to bring the top of the 4in. lineable with the top of the 6in. pipe, the development being below the axis of the 4in., thus giving full advantage of the enlargement, otherwise when the 6in. is running full the sewage must back up into the 4in. Taper bends, when required for similar purposes, should also be advocated.

It is not an uncommon practice to make an increasing joint by thrusting the spigot of the smaller pipe into the barrel of the larger one and packing the joint in the ordinary manner between the two. This leaves a ridge or projection of more or less size in the inside of the larger pipe, which is not satisfactory. Another way is by cutting the barrel off within an inch or so of the socket of the smaller pipe and bevelling the inner edge of the spigot thus formed. This is then inserted into the larger pipe, the socket of the smaller one, in certain cases, fitting into the socket of the larger one, leaving just sufficient space between the two to make a joint. This method is a troublesome one, and not to be compared with that of purpose-made taper pipes. When stoneware pipes are required to be cut they should be stood on end and filled with sand, the inertia thus produced reducing the liability of fracturing or cracking the shell.

Section 3.

The question of soil pipes is as important a part, if not more so, as any portion appertaining to the house drainage system, both as regards material

and workmanship. It is a great mistake on the score of economy to use cheap soil pipes. These are cheap, perhaps, to the builder, but dear, to say the least of it, to the owners and occupiers, especially when they involve sickness and consequential trouble and expense.

The best material for soil pipes is drawn lead, weighing not less than 8 lb. to the superficial foot. Cast and seamed lead pipes should not be used for any drain purposes, they being subject to pinholes and other weaknesses, and therefore not to be depended on, besides which they will not stand bending.

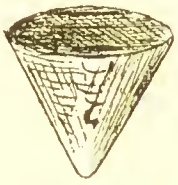


Fig. 15.

The advantages of drawn lead pipes are that they are smoother and less absorbent than other pipes, conducing to cleanliness and the reduction of fouling to a minimum, they are also more reliable and durable, being less affected by the weather. They are less cumbersome, and can be bent into any position required.

The wiped joint is the strongest and best for all lead pipes. It is no easy matter to make a satisfactory joint of this description; on the contrary, it requires a large amount of skill and experience on the part of the plumber before he succeeds in mastering this difficult part of his craft, and it naturally follows that such work, if required good must be well paid for. In the first place there must be a socket and spigot for one pipe to fit into the other, as in the case of drain pipes, but in this

instance such sockets have to be formed by the plumber at the end of the pipe, instead of these being ready made by the manufacturer. This part of the work is of all importance in order that no part of the pipe or joint should be weakened, and that no solder can gain access through the joint into the interior of the pipe.

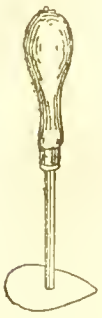


Fig. 16.

The best way to obviate such defects is to form the socket by opening the end of the one with a wooden tan pin (Fig. 15) to a sufficient width to receive the spigot end of the other pipe, which should also be treated slightly in a similar manner, with the outer edge rasped off till very thin in order to make it take its bearing and become a true fit with the interior of the socket. This being done, any grease that may exist should be removed, and the ends painted a few inches up the external and internal surfaces, with a mixture of vegetable black or lamp black, glue,

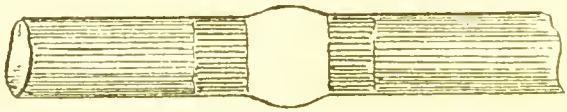


Fig. 17.

and dried chalk or whiting, and upon its becoming dry the external surfaces of both socket and spigot for an inch or two, according to the size of the pipe, together with a small portion round the

inside of the former, should be shaved with a shaving-hook (Fig. 16), removing the paint and a very thin portion of lead, leaving them perfectly bright; to prevent tarnish, tallow should be rubbed over these bright parts. After the pipes have been properly adjusted, the solder, which is attended to by the plumber's mate, whose duty it is to see that it does not become overheated, consisting of one part of tin to three parts of lead, is now applied, being poured round the shaved portions of the pipes. The joint is then wiped into shape by means of a thick soldering cloth, which consists, as a rule, of moleskin well greased on the surface with tallow (Fig. 17).

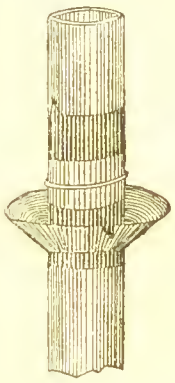


Fig. 18

Plumbers wipe as many of their joints as possible in the workshop, but there are cases where upright joints have to be made. In these cases, to prevent waste of the surplus solder while making the joint, which would otherwise fall to the ground, a lead collar, well soiled, should be fastened round the soiled part of the pipe just below the joint (Fig. 18). This will catch the solder, which upon cooling can be easily removed.

Next to the wiped joint, but a long way from being near it as regards perfection, stands the blown joint and the copper bit joint, neither of which, in these days of high sanitation, should be used. Good plumbers, as a matter of fact, will not adopt

them for sanitary purposes. They consist, in the first instance, of the lower end of the top pipe being thrust into the upper end of the lower in a similar manner to that of the wiped joint, only to a greater depth. This being done in the case of the blown joint, the part where the joint is required to be made is heated by means of a flame blown against it by a blow-pipe, and a stick of solder is

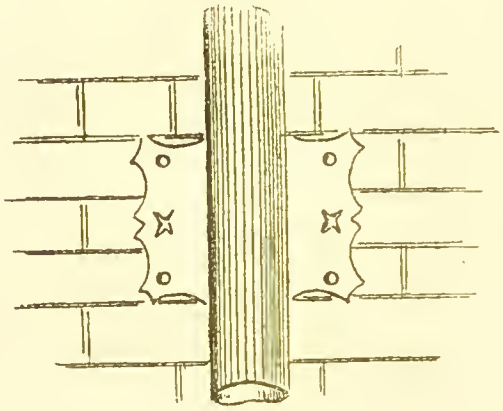


Fig. 19.

heated by the flame and run all round the joint till the socket is filled. The copper bit joint, which is inferior to the former, is made by a stick of solder being melted into the space between the spigot and socket by means of a heated soldering iron, which has a copper end or bit. The solder for these joints consists of more tin than that used for wiped joints.

It is a mistake to use soil pipes of too large a diameter, as they only afford additional surface

to become foul, and are not so self-cleansing, by the action of the flush, as smaller ones, and, further, they are more cumbersome and costly. As a rule, 3 or 3½in. lead soil pipes are sufficient for general purposes.

All soil pipes should be fixed outside the house wall in the external air, as it must be remembered that the house drains, to a great extent, ventilate through the soil pipe; and should it be defective through age or accident the foul air would, in most cases, simply pass out into the open atmosphere, but if fixed inside such air would be introduced into the dwelling, thus setting up a dangerous nuisance.

The proper manner to fix lead pipes is by lead tacks, which are plates of lead, about 8in. long and 4in. wide, soldered on to the back of the pipe. These plates should be made of good stout lead, not less than 8 lb. to the superficial foot, which is very necessary when the weight of the pipe to be fixed is reckoned. These tacks should be put on the pipes in pairs, one pair for every six feet, and fastened to the wall by two large lead-headed galvanized iron wall-nails to each tack. (Fig. 19.)

The best position for soil pipes is facing south, where they will not be so much affected by frost and cold, which eventually affects the wear of the lead; and, further, a warm pipe increases the ventilating velocity. They should also be sheltered as much as possible in the nook between the walls of the house and back addition, but at the same time should have as few angles and curves

in their course as possible, as not only do angles impede the flush, but also the ventilation, and cause extra wear and tear.

The connection between the lead soil pipe and the drain should not be by merely thrusting the foot into the stoneware or iron bend as far as

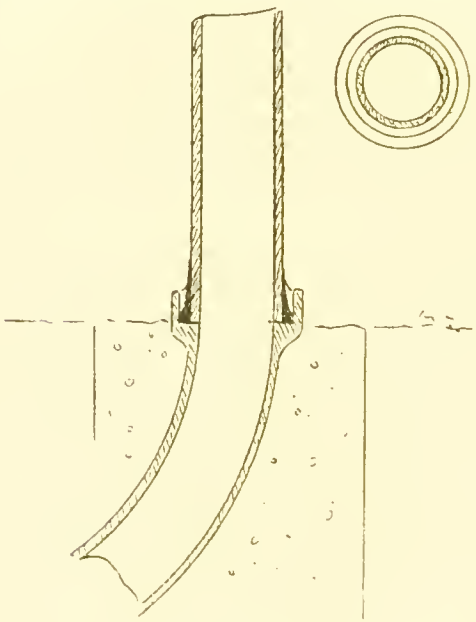


Fig. 20.

it will go and then filling in the joint with cement, but the lead pipe should be slightly opened, bell-shape at the end so as to fit the socket of the bend, and then the joint properly cemented and made tight; or, what is better, a circular brass collar should be soldered round the end of the pipe,

and extend three or four inches up the sides, being slightly thicker at the base, which would allow of a firmer joint to be made in cement or lead. (Fig. 20.)

Iron soil pipes are much used, they being cheaper than lead, and if the work is well done are almost as successful. The too common practice amongst plumbers of using ordinary rain-water pipes jointed with red lead or putty is to be condemned, as not only are the joints insufficient, but the pipes not being intended for such purposes are much too flimsy to stand a proper test, or to be safely caulked.

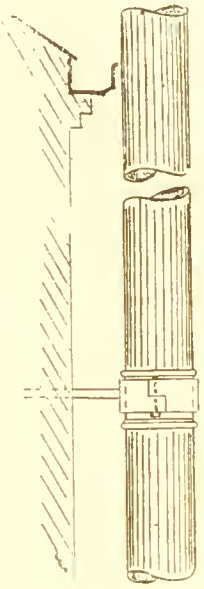


Fig. 21.

When iron pipes are used they should be heavy soil pipes in 6ft. or 9ft. lengths, and not less than $\frac{5}{16}$in. in thickness, with good deep sockets, not less than 4in., and fixed against the wall with proper iron collars fastened round the sockets and secured by means of arm pieces into brickwork. (Fig. 21.) The spigots should be provided with a bead all round to fit easily into the socket, and after a few strands of gasket have been carefully forced between spigot and socket, the latter being upwards, the remaining depth of the joint should be made with melted lead and then finished with a

caulking tool, at the same time taking care not to overdo it and split the pipes. All iron soil pipes should be coated inside with some special process to prevent corrosion and to preserve the metal, such as with Dr. Angus Smith's solution, or painted with Blundell's petrifying liquid, or three coats of oxide, or glass-lined.

Galvanised iron pipes are much used for this purpose, but they also require special inside treatment, as it is found that the surfaces undergo rapid deterioration under the action of sewage. Galvanising consists of covering the iron with a thin coating of zinc by placing the heated pipes in a bath of chloride of zinc and afterwards into melted zinc and cooling off.

CHAPTER III.

VENTILATION OF DRAINS.

The usual mode of ventilation of house drains is by means of metal pipes attached to the highest part of the drain and carried up in the open air to an elevated position, an inlet being provided at the lowest part of the drain. By this means relief is given to the pressure, and a current of fresh air is induced to course through the drain, removing offensive and impure odour.

It is of the utmost importance that drains should be well ventilated, as the more open they are kept the less likely they are, not only of becoming foul, but for the air to find its way through any fracture or defect that may exist, into the house, it being easier for it to make its escape into the open air through an unobstructed ventilation opening.

The number of inadequate and unworkable methods of house drain ventilation that from time to time have come before the author's notice is considerable, to say nothing of the dummy ventilators which every now and then are discovered. In some cases every endeavour has been made to effect a good system, which on testing has been found a non-success.

To carry out a good and effectual mode of house ventilation requires something more than the sticking up of a pipe, or the results may be

even more pernicious than the evils it is intended to prevent.

In ventilation of house drains there should be at least one inlet and one outlet pipe for the purpose of extraction. The inlet should be placed low down, and at the foot of the drain, the outlet being

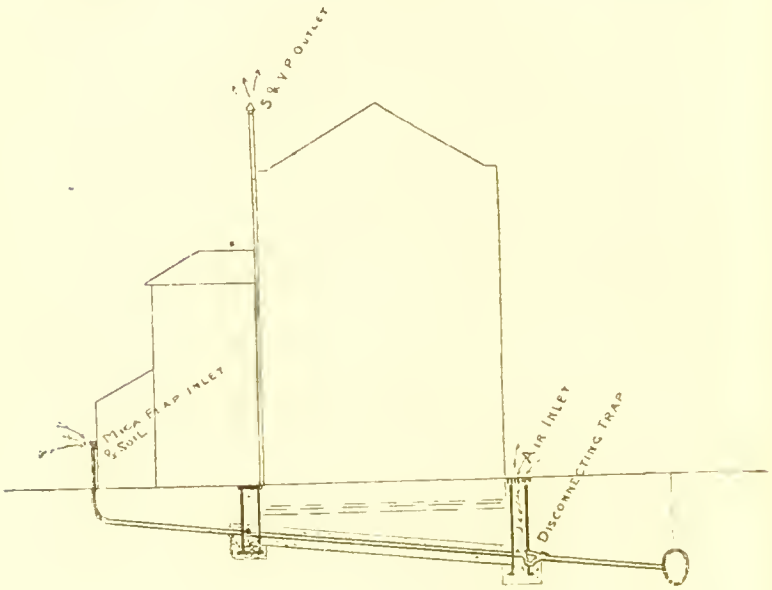


Fig. 22.

taken off the highest part and carried up some height, as by so doing the movement of the column of air, supposing the surrounding circumstances to be favourable, will be regular. The fresh air being admitted at the inlet, which on becoming warmed and therefore expanded and lightened, will rise up to the highest part of the drain and up the venti-

lator, the latter assisting its velocity by the current of air passing over its open end. The air inlet is generally fixed in conjunction with the disconnecting trap a contrivance by which the house drain is cut off from a direct communication with the sewer.

In cases where the closets are in the centre of the building, *i.e.*, between the main building and back addition, the principal outlet can be taken up at this point, but should the drain extend further on, as is the rule, to pick up sink gullies and outside w.c., &c., another ventilation pipe should be carried off the extreme end, and terminate lower down, away from all openings, into the house. This will then act as an inlet for that part of the drain, and the one outlet will do service for the two inlets. (Fig. 22.)

Outlet ventilators can be in connection with the main soil pipes, which must be carried up full bore without any bend, if possible; terminating well above any windows, and away from any chimney or other openings. It is, however, preferable, for the purpose of ventilation, to have a separate outlet pipe in connection with the drains, as when the soil pipe is in use the ventilation is affected, and further, it is not always necessary for soil pipes to be as much as 4in. in diameter, but outlet ventilators should not be less than that size, and the dryer they are kept internally the better they work. The separate outlet and the soil pipe can, as a rule, be fixed side by side, and the latter, which must always have an open

end above where the top connection is made, instead of being carried up, can be turned into the side of the former—an expedient which would also apply to anti-syphonage pipes. No soil pipe should be trapped at the foot when disconnecting traps are used.

Where more than one closet discharges into a

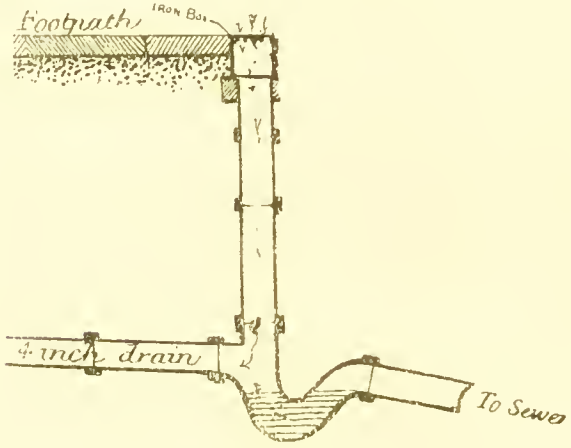


Fig. 23.

soil pipe, which, as before stated, should always be carried up full bore, and caused to ventilate above the roofs of the houses, the out-go pipe between trap and soil pipe of all closets should be connected to an anti-syphonage 2in. in diameter, and the same carried up full bore abreast of the soil pipe and terminated into its side above the top fitting, unless other provision is made as before mentioned. The principal inlet ventilator at the foot of the drain

should always be placed close to the disconnecting trap and on the house-drain side, a junction as a rule being provided on the trap for that purpose, which should be carried up in stoneware glazed pipes, properly jointed together, and terminating on the edge of the path, and the open end covered with an air inlet and dirt-box grating, which should be fixed level with the path. (Fig. 23.) This is

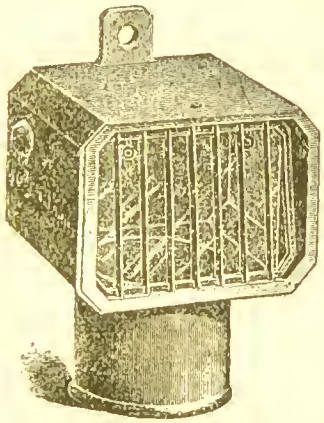


Fig. 24.

the method adopted by the Local Government Board in their "Model Bye-laws," and is, in the author's opinion, having watched the results of some thousands of cases of its employment, very satisfactory.

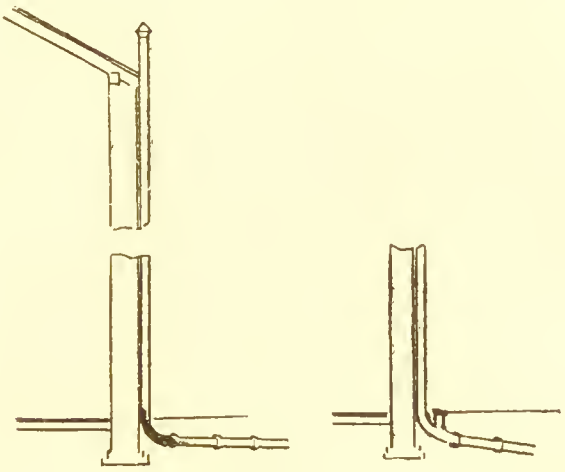
In some cases of drainage, more particularly in connection with cesspools, the mica flap valve air-inlet ventilator is used. (Fig. 24.) This inlet is supposed to work automatically by the valve

opening to let the fresh air pass in, and closing immediately any back-pressure takes place. It is well, however, not to trust too confidently upon this action being permanently maintained, as the mica valves are not always to be relied upon owing to their getting out of shape, and not properly closing, or in some way becoming damaged. Should the valve be in good order, the proper fixing of it also has much to do with its effective working. The valve box should be fixed a little inclined towards the front, till the flap is quite closed by its own weight. By so doing the valve will not remain open, when not admitting air, for the escape of any foul smells from the drain.

The outlet ends of ventilators should, in cases where there are no houses, chimneys, or trees at a greater height anywhere near that might produce a down-draught, be protected from birds building nests in them, by a wire cage; but should there be any danger of down-draughts a good open cowl, finished off to the pipe, with wire work, or other similar contrivance, is necessary to prevent the wind blowing down the outlet, and sending occasional puffs of air up the inlet.

Ventilation pipes should have as few bends as possible, but in cases where these unfortunately cannot be avoided they should be long and slow, so as not to impede the air current, and to prevent as much as possible any rust, incrustation, or other foreign substance from finding a resting place in them. It is also important that ventilation pipes,

when independent of a w.c., or flushing arrangement to keep them clean, should be provided with an inspection eye at the foot, to prevent their becoming stopped up with rust, &c., falling down the pipe, and lodging at the bottom. (Figs. 25 and 26.) It is preferable in such cases to use lead



Figs. 25 and 26.

pipes to iron, as they are not subject to rust or scale.

Traps under lavatory basins and scullery sinks should be ventilated by inserting 1½in. anti-syphonage pipe at the top of trap outlet, and for single wastes carrying it through an external wall, leaving the end open in the air. In the case of a range of basins, the trap under each basin should be vented in precisely the same manner as the latter and carried into one common 2in. anti-syphonage pipe,

terminated in the external air. All ventilators should be connected above the water-line in the pipes; if not, when the drain is in use, the vent opening may be water sealed, and thereby rendered useless.

CHAPTER IV.

Section 1.—Traps and Gullies.

Traps are arrangements in connection with drains which arrest the flow of air or gas into, out of, or along a pipe, and where the sewage or water automatically forms the seal.

Gullies are special forms of traps placed on drains or at the end of branches to give free inlet to waste waters and other matters, and at the same time prevent the escape of any air or gas from the drain, either when the gully is in action or not. There can be no doubt that the question of traps requires close attention, as these are the principal barriers relied upon to arrest the foul air present in drains and prevent its escaping into houses or other places where its effects might be injurious to health. Their internal surfaces should be as small as possible compatible with efficiency, and fitted with suitable arrangements for inspection and cleansing. Every sanitary arrangement in connection with the drains and inside of houses should be trapped, and the trap fixed as close to the apparatus as possible in order to leave no portion of the connecting pipe open to the internal air.

To effectually prevent the passage of drain air, every waste pipe from apparatus inside houses, with the exception of w.c.'s, urinals, and slop sinks; such as scullery sinks, lavatory basins,

baths, &c., after being trapped by means of a syphon trap (Fig. 27), should be taken through an external wall and made to discharge in the open air, over a channel leading to a properly-trapped

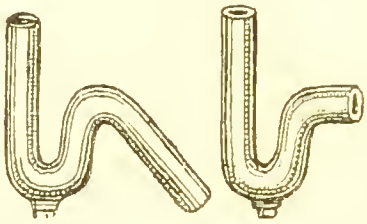


Fig. 27.

gully. (Fig. 28.) In the case of the waste pipe being on a higher floor than the gully, it should be connected with a special waste pipe carried up with an open end as a ventilator, and discharging

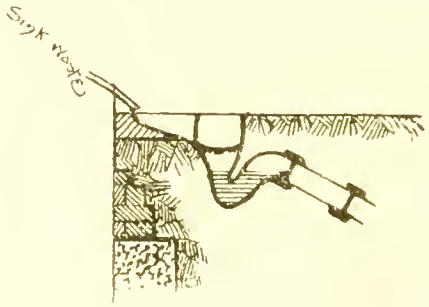


Fig. 28.

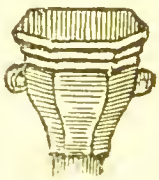


Fig. 29.

in the open air at the foot. These wastes are, however, in some towns made to discharge by means of a "swan-neck" into an open cistern head (Fig. 29) leading to a gully trap, which is not

to be recommended, owing to the cistern-head becoming very foul. The "Model Bye-laws" of the Local Government Board require wastes to discharge over a channel at least 18in. distant from the gully, and this condition successfully answers two purposes, viz., in the case of the escape of drain air through the gully, the waste pipe will be sufficiently far away as to be out of danger as an intake; and, again, in the case of sinks, the water and grease will have an opportunity of cooling before entering the drains by being exposed to the open air—another good feature in this arrangement. Overflow pipes from cisterns, and all descriptions of safes, should not in any case be made to discharge directly over a gully, but in some suitable, conspicuous position, where waste of water would be immediately detected, and the cause remedied.

All rain-water pipes for the conveyance of water off roofs should discharge at the foot in the open air over trapped gullies. In this way, should the gully become stopped, it can easily be cleaned out, and in cases of drought where there is insufficient rain to seal these traps, they can be regularly attended to and the water supply replenished, but if the pipes are connected up directly with the trap, upon the latter becoming stopped, there being no means of access for cleansing purposes, the water must rise and stagnate in the pipes or escape through the joints and cause damp walls, whilst in the time of drought the trap upon becoming unsealed would allow the drain air to ventilate

up these down pipes and cause a nuisance. It is a mistake to make openings in drains to receive small and ntermittent quantities of water, as there may not be sufficient usage of the gully to remain sealed, therefore in all cases of this description, where such connections are required a second waste pipe from a scullery sink or bath should also be taken into it in order to keep the gully charged.

Gullies should never be placed inside houses ; it is a very dangerous practice, as the most evil results must necessarily follow, either through the trap becoming dry or the drain air forcing itself through the water seal. All gullies should therefore be placed outside in the external air, and all waste pipes made to discharge with open ends also in the external air.

It is an important feature to have the waste pipes of apparatus, such as scullery sinks, baths, and lavatory basins, trapped, although some may argue that owing to these being disconnected and made to discharge in the open air over gully traps there is no necessity for so doing, and, further, that traps are a disadvantage as the water is obstructed in its flow. But it is obvious that such traps, besides shutting out of the house any smells that may emanate from the filth in the gully trap and waste pipe, &c., prevent, in case the gully becomes unsealed through defect or otherwise, the escape of drain air, which, owing to the warmth of the inside of the house, as compared with that of the outside, may be drawn or blown through the sink

waste. It is a frequent occurrence that in removing the bucket of the sink gully for cleansing purposes the water-line is lowered, and sometimes the trap left unsealed until the sink is again used. This would certainly give a facility for the admission of drain air into the house should there be no proper trap to the sink waste. Again, if not for the trap, the waste pipe itself being corroded with decomposing matter, would be a vehicle for fouling and passing tainted air into the interior of the house. In the case of baths and lavatory basins, these arrangements are generally situate above the ground floor, and have, therefore, long lengths of waste pipe, and although there may be sufficient disconnections in their course the results will not be satisfactory unless the bath is trapped, as after a time the pipes become coated with grease and other filth, and throw off objectionable effluvia, which is liable to be drawn into the interior of the dwelling.

It takes a good deal of discretion in selecting the best trap for various purposes, there being such a variety to choose from. The form of trap suitable should therefore be considered in conjunction with the position and purpose for which it is required. Good traps should have a dip of not less than 2in., to prevent their becoming unsealed.

The two principal enemies which traps have to fight against are syphonage, and the excess of air pressure to which drains are occasionally subjected. Syphonage is caused by a vacuum set up in drains. This is occasioned chiefly by the ventilation being

insufficient, and being so a sudden flush immediately sucks the water out of the nearest trap to give ingress to the required amount of air displaced, and thus leaving the trap open for the escape of drain air into the house. The excess of air pressure in drains is again a matter of ventilation, which owing to the momentum and force of the water passing through the drain an amount of air is displaced in its course, this air forcing its way through the least resisting outlet, and should there

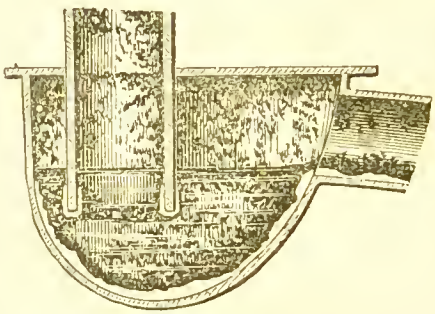


Fig. 30.

be no ventilation pipe it will escape through the water seal of the nearest trap. It therefore shows that a good dip should always be insisted on, especially in the case of those traps which are subjected to sudden and rapid flushing, under which circumstances they are liable to run themselves unsealed. Too much care cannot be exercised in fixing traps, as often a good trap will be rendered useless by being badly fixed. For instance, traps should be kept perfectly upright, and not allowed

to fall over towards the front, for if this be the case they will not form the trap required, and perhaps will not seal. They should also be made of the

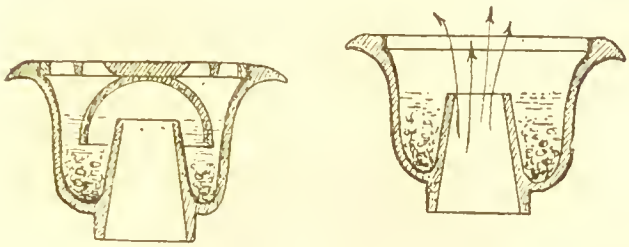


Fig. 31.

same materials as the drains with which they connect, so that they can be satisfactorily jointed, as it would be almost as well to have no trap as bad joints.

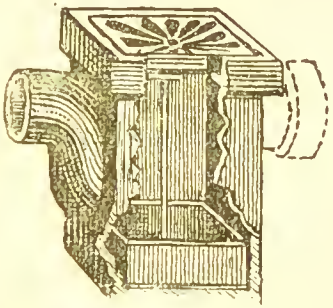


Fig. 32.

Gullies when at the ends of branch drains should always be set up in connection with the drain on a good bed of cement concrete, and well sur-

rounded with that material. By so doing the trap is not only materially strengthened, but at the same time is afforded that additional support required for the ends of the branches, especially as the trap is of extra weight, and as a rule, furnished with very little bearing surface. The manner of jointing gullies with the ends of

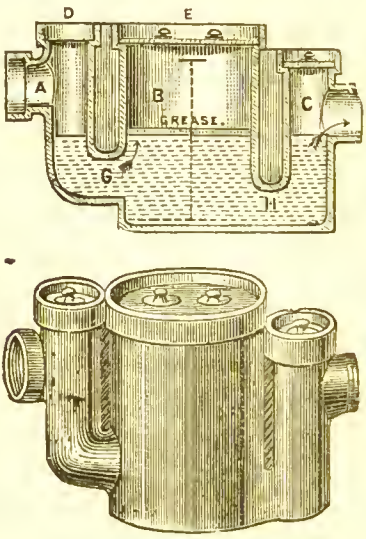


Fig. 33.

drains should be noted. As a rule, the outlet of a gully with a strand or two of gasket fastened round it is placed into the socket of the drain pipe and the joint cemented up. This, although the general way, is not quite satisfactory, it being difficult to make a good and perfect joint without proper access to the interior of the pipes, which cannot be obtained

through the trap. To gain this access the last length of pipes to which the gully is to be fixed should have an inspection eye or square junction at the top, which, upon the joint being finished, and any surplus material inside the pipe removed should be closed over with a proper stoneware stopper and cemented down. It is a mistake to use gullies and traps larger than is necessary, but no gully should be less than 4in. inlet, at the same

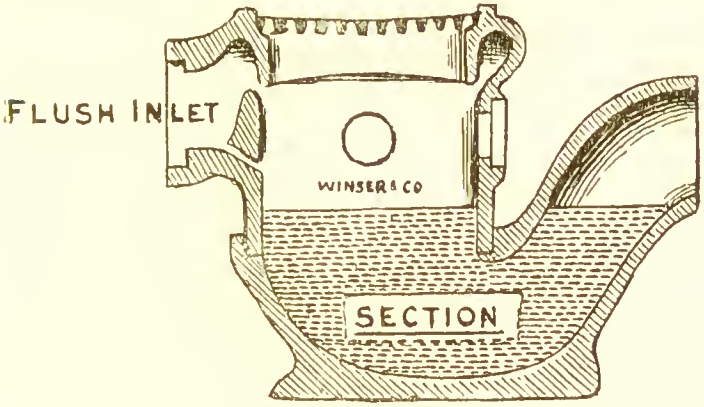


Fig. 34.

time, a 4in. gully with 6in. outlet is sufficient for a 6in. drain for most ordinary purposes. The traps known as the D and Bell traps should never be used in modern drainage; the D trap (Fig. 30) being anything but cleanly, and the Bell very unreliable. (Fig. 31.)

To prevent the drains becoming coated with grease, which frequently is the cause of much trouble and derangement, proper grease-traps

should be fixed to receive the sink waste water in order that any fat that may exist may either be intercepted or cooled before entering the house drains.

Fig. 32 shows an ordinary small grease-trap with bucket. This trap is of little use unless the grease is regularly removed and trap cleansed.

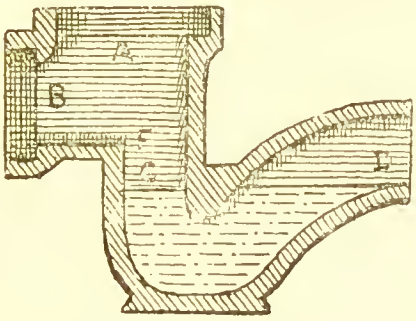
Fig. 33 illustrates Buchan's patent grease-trap. This trap is manufactured by Messrs. Craig, and is one of the best of its kind. The sink waste water passes under G and H before entering the drain at C, giving the grease good opportunity of either collecting in the principal chamber B, and readily removed at E, or of becoming set, and thus not clogging the drain.

Fig. 34 is a grease-trap with flushing rim to enable the contents to be occasionally flushed out by means of an automatic syphon cistern.

Section 2.—Interception.

All communication between sewers and house drains should be cut off by means of a proper intercepting trap. In other words, in order to keep back from the houses any air out of the sewer, or air from one house drain, wherein there may be infection passing into the drains of another house, and thereby tending to spread the disease, an intercepting trap must be fixed, as otherwise all the house drains will be connected one with the other, and the sewers ventilated through the drains, by which means in time of an outbreak of infectious

disease, contagion may perhaps spread through the defective drains and cause an epidemic. In cases where the interceptor is not used, it is tantamount to laying on the bad air from all filthy and neglected drains, including the line of sewers, with the house drain, and all that is required is an outlet from imperfect work or an accidental fracture for the occupiers to have a plentiful supply of the mixture. The Model Bye-laws require such an



BUCHAN'S TRAP

Fig. 35.

intercepting trap to be provided between all sewers and house drains, with a pipe or shaft carried up vertically on the house side of same, to act as an inlet air ventilator.

The intercepting trap should also without fail be used to disconnect the house drains from cesspools and similar receptacles, where there is no better method of drainage provided.

All intercepting traps should be of best glazed

stoneware or iron, and at least one-twelfth the diameter of the trap in thickness, and free from any roughness or air-holes in the manufacture. They must be well shaped and with a water seal of 2½in. at the least. The interceptor should be

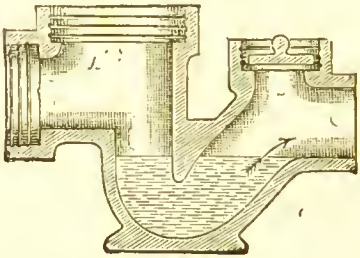
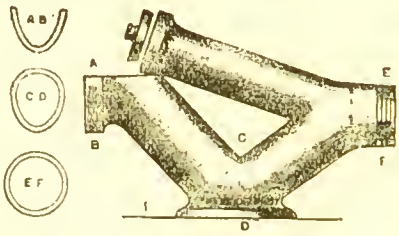


Fig. 36.

set perfectly level, so as not to cause any undue impediment in the flow of sewage. Too large a



"IMPROVED KENON"

Fig. 37.

trap should not be used, but a 4in. trap is sufficient for either a 4in. or 6in. drain and a 6in. trap for a 9in. drain.

Some of the principal intercepting traps used are:—The "Buchan" trap, made by Messrs. J. and

M. Craig, Ltd., as illustrated in Figs. 35 and 36, is one of the best forms of trap where no inspection chamber is used, as it can as a rule be kept clean and, if required, unstopped from the air inlet shaft, which should be at least 6in. in diameter. The "Improved Kenon" disconnecting trap, manufactured by Messrs. Crapper and Co., Fig. 37, is well designed to be used in an inspection chamber, as it affords a good raking arm into the sewer, and

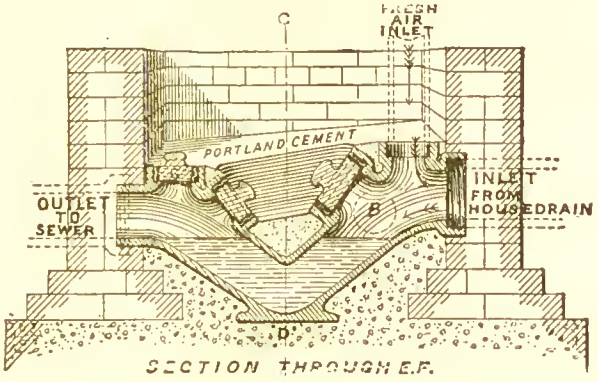


Fig. 38.

the mouth after leaving the open channel of the house drain, being egg-shaped, provides a deeper flow and better flush of sewage than others.

Sykes' patent interceptor is another ingenious production in connection with an inspection chamber, and when used no open channel is required, as the trap forms everything necessary, as will be seen by the above illustration (Fig. 38).

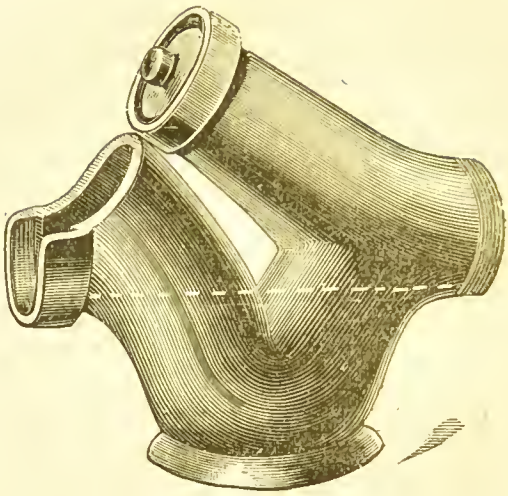


Fig. 39.

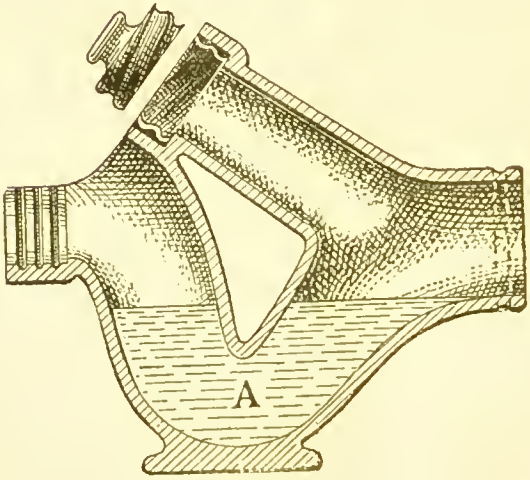


Fig. 40.

Winser's parallel intercepting sewer trap (Fig. 39), which has the inlet and outlet on the same level, is useful in cases where the fall between house and sewer is limited, and in all such cases an inspection chamber should be provided.

Fig. 40 shows a good interceptor, manufactured by the Albion Clay Company, Limited, a special feature being, that the raking arm is fitted with Sykes' Patent Screw Plug, which safely prevents the escape of sewer air into the chamber.

CHAPTER V.

Inspection Chambers.

Inspection chambers or manholes are shafts constructed in the course of drains, and conducting thereto for the purposes of supervision and cleansing, so that in the event of obstruction in, or acci-

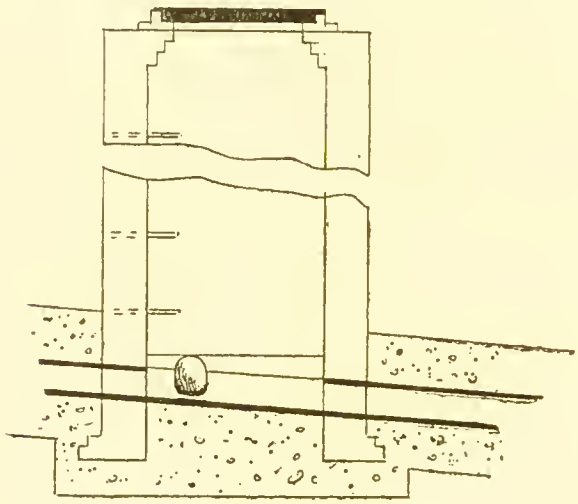
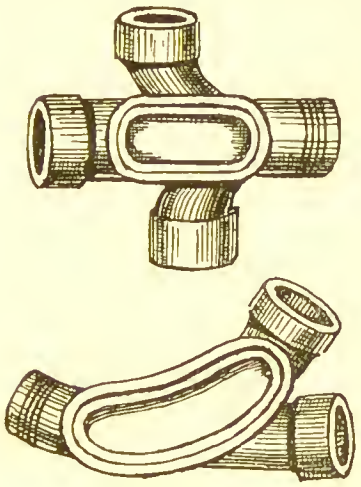


Fig. 41.

dent, such matter may receive immediate and effective attention. Inspection chambers are, as a general rule, placed at angles in drains, or where junctions occur and are fitted with sealing covers, thus preventing the escape of air or gas, and although they may not appear imperatively

necessary in cases of small and simple systems of house drainage, still it is most desirable that access to all drains should be thus readily obtainable. Inspection chambers should in every instance be provided at both ends of the length of drains which pass under houses or in immediate proximity to a water supply, and in situation of similar importance



Figs. 42 and 43.

in order that occasional examination of such drains may be made and their soundness ascertained. (Fig. 41.) In the absence of means of easy access it would be impossible to efficiently and satisfactorily conduct such examinations without incurring much expense and delay, by excavating the ground and opening down to the drains for the purpose. Inspection chambers ought also to be placed at

every point where the drain deviates in its course to any great extent from the direct line, and drains should be so planned that as many branch drains as possible converge to and connect up by means of open bends within the chamber. When, however, it would require to extend branch drains to

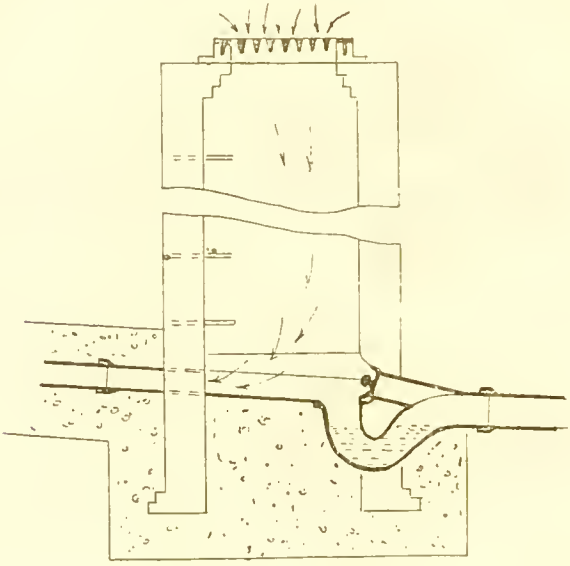


Fig. 44.

any considerable length to form this connection, it is better that inspection pipes should be employed in such cases. These inspection pipes are ordinary pipes with an opening at the top; they are particularly useful in providing means for examination of branch drains, and should be regularly used for that purpose. (Figs. 42 and 43 and raising piece.)

In the cases of long lengths of house drains, it is requisite that inspection chambers be provided at frequent intervals in their courses to afford proper supervision and control. It is advisable, moreover, to place an inspection chamber in connection with intercepting traps upon the house side of the trap, so that in the event of its becoming choked as sometimes happens, ready access and relief can be at once obtained. (Fig. 44.)

These chambers should be constructed square in plan, with walls of good hard stock bricks, or other non-absorbent materials 9in. in thickness, on good

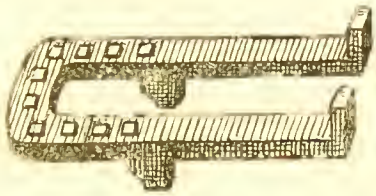


Fig. 45.

footings, and in cement mortar throughout, and with proper struck joints. When deep, step irons should be built in on one side of the wall to form a ladder. (Fig. 45.) The floor of the shaft should be of 9in. of good Portland cement concrete properly rammed to the levels required for the channels. The main invert channel should be laid with correct levels, and embedded in fine concrete which should be extended to the sides of the chamber, with a good fall to the central main drain, and well benched up in cement. The sides of the chamber should be

rendered in cement to the height of a few feet above floor level, and at the top of the chamber a square inspection cover frame should be fixed, the brickwork being corbelled over if necessary. The

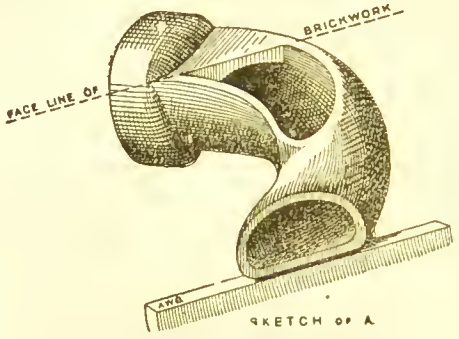


Fig. 46.

main invert channels used in these chambers should be of the same size, and laid at the same gradient and level as the drain. The open channel bends should be constructed so as to prevent the

Fig. 47.

sewage splashing over the channel and depositing on the sides, or on the benchings and corners, thereby rendering the inspection chamber filthy and unsanitary. To obviate this it is necessary to use channels specially manufactured for that pur-

pose, the old system of employing ordinary semi-circular channels not being continued.

Jones and Sykes' patent channel bends (Fig. 46) have been designed to deliver the sewage into the main channel in a cleanly and efficient manner, without creating any undue disturbance in its regular flow. Winser's channel pipes (Fig. 47) are constructed with a similar object, and are very satisfactory in operation. In these the outer side is carried higher than the inner and curved inward, thus counteracting the tendency of the sewage to

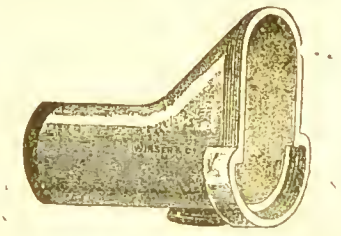


Fig. 48.

overflow on that side and preventing its so doing. This firm also manufacture a special drain chute for inspection chambers. (Fig. 48.) This is a pipe the upper side of which is opened to form a hood at the socket end, and is useful as the first outlet pipe from open channels. It affords easy access for the cleansing rods.

Inspection chambers should be covered with proper iron sealing covers, such as Adams', Crappers', or Jones' (Fig. 49), and have a flanged edge fitting into a groove in the frame. This groove should be run with Russian tallow in order to

render the fitting air-tight, and as drain air is apt to accumulate in inspection chambers, it is advisable to place an air inlet (such as the mica valve ventilator) at the top of the chamber in order to maintain a current of air through it. Double sealing covers are to be recommended, such as Jones' patent. (Fig. 50.) When the drain is situate at a

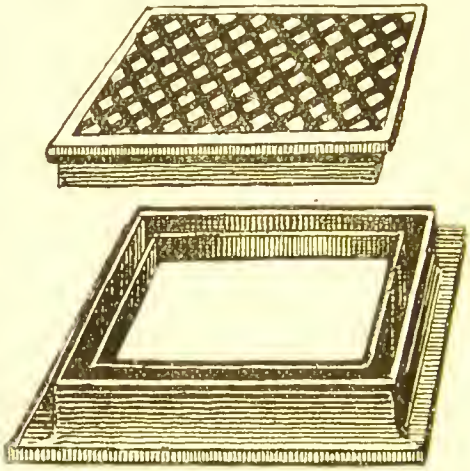


Fig. 49.

short distance from the surface of the ground, the use of inspection pipes and eyes may be adopted in lieu of inspection chambers. These pipes and eyes are manufactured in a variety of shapes, but in the best forms the sides of the pipes are brought up higher than usual, and constructed with rectangular openings above the ordinary water-line. These openings should be fitted with locking

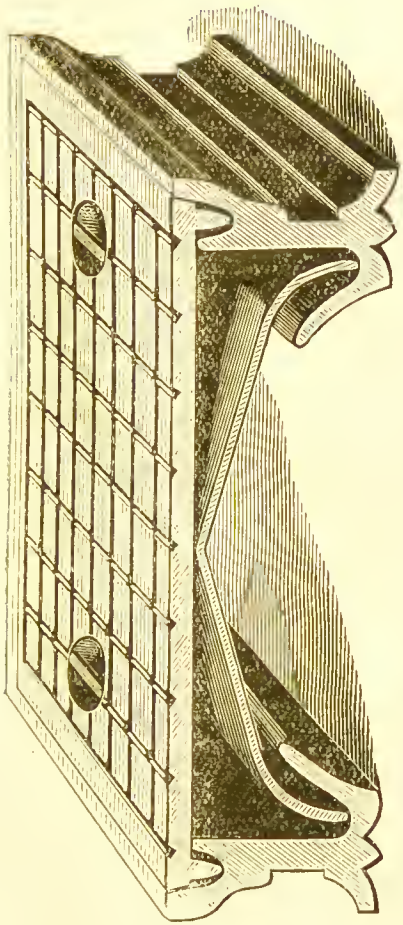


Fig. 50.

covers to prevent any internal pressure from bursting them open. Circular inspection eyes at the ends of drains and other places for cleansing and flushing purposes should be provided with screw stoppers and blocks, and by the use of Russian tallow between the joints they are rendered effectually air-tight.

CHAPTER VI.

Section 1.

Internal Sanitary Fittings.

These fittings, which include water-closets, slop and other sinks, flushing cisterns, urinals, baths, and various other internal arrangements in connection with house drains, are matters on which much can be said, and mainly that the best appliances should be used, seeing that good drainage is often tainted and rendered unwholesome by the use of unsuitable or inferior and insanitary fittings. The principal of these fittings requiring attention is the water-closet apparatus, which is a trapped opening to the drains, and generally located within the dwelling; therefore should be perfect. The water-closet apparatus has taken many years to bring to its present state of cleanliness, and to ensure this condition the simpler its construction the easier it is to maintain in order. Much improvement has of late years taken place in this form of sanitary work, superseding to a great degree the old appliances.

It will be more convenient to divide the subject of water-closet construction into two sections:— Firstly, dealing with those forms of apparatus which, although unsanitary and obsolete are still to be found in use (some of the better description of this class being still fixed by unscrupulous builders when

opportunity occurs for so doing), and secondly, with the most suitable forms of apparatus.

By far the worst possible form of water-closet apparatus now found in use is the pan water-closet (Fig. 51). This apparatus is fitted with a copper pan having plenty of angles to hold filth,

Fig. 51.

which, when the pan is not in a leaky condition, holds water in the basin. The pan upon being tipped discharges its contents into a receiver, and at the same time exposes the contents of the latter foul receptacle to the house. The receiver is a large iron receptacle, affording every facility for the deposit of sewage; this receiver generally discharges into the soil-pipe through a D trap, which is another highly-objectionable arrange-

ment, the whole—or part, in most instances—being flushed through a fan spreader at the back. Altogether this apparatus is a combination of the most unsanitary contrivances. Now-a-days, however, very few words are required in condemning this apparatus, and the Sanitary Inspector, should people insist on letting it remain, can require the occupier to occasionally remove the receiver for burning-out purposes, the annoyance and cost of doing this soon inducing the householder to get the closet replaced by a proper appliance.

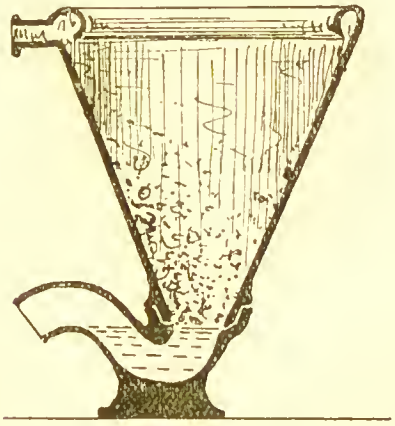


Fig. 52

Furthermore, the model bye-laws of the Local Government Board prohibit its use in new buildings.

The old hopper water-closet (Fig. 52) is another unsanitary contrivance. The main fault in this closet is the basin; it being conical in shape, the

surfaces become filthy from top to bottom, and whether fitted with flushing rim and good flush or not it after a while becomes quite foul and objectionable. The plug or plunger closet (Fig. 53) consists of a basin, at the side of which is a chamber provided with a plug, fitting down into the mouth of the trap. This plug is intended to retain a body of water in the basin, and upon being lifted and the apparatus flushed, gives outlet to the contents of the closet. This apparatus is not a good one, there

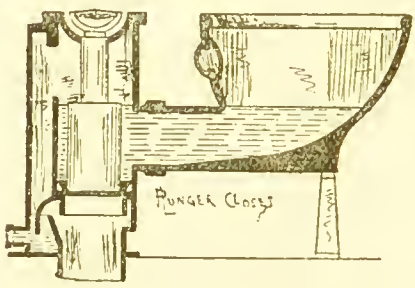


Fig. 53.

being a great deal of surface exposed to the air of the house when in action, and the plug chamber, which is not easily accessible, becomes filthy, besides which the action of the plug is not to be relied upon, as it is very liable to lose the water flush from the leaky state of the plug, which is generally its normal condition.

The wash-out closet (Fig. 54) is a more modern form of apparatus, the basin of which is made to retain water at the bottom by its being hollowed.

The closet is not satisfactory, being rather

odorous, owing to the soil not being properly immersed in water till reaching the trap, and upon being flushed is broken up and dashed against the outlet and then into the trap, from whence it generally has a difficulty in clearing itself, and often remains there till again used.

It must not be taken for granted that a good-looking closet is a sign of its being sanitary, as

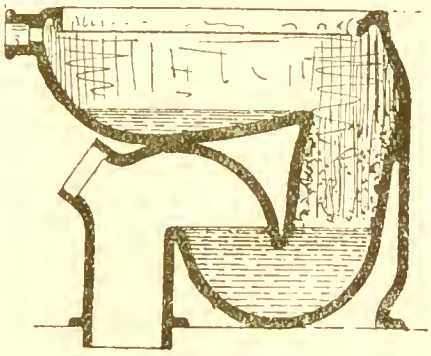


Fig. 54.

some of the bad forms are well got up and highly ornamented, especially inside the basin, which is very seldom done in new forms, they being as a rule plain white.

The old custom of framed-in closets is a mistake, although some people, who have a fancy for their apparatus appearing like a piece of furniture, prefer them so done, the result being that a fœtid odour is inseparable from them. They are also frequently a screen for bad work. The author has on several occasions been called in to investigate cases of

certain rooms in houses being unusually close and foul smelling, and has invariably had to attribute the cause to the use of framed-in closets, and upon these being removed, and the defects remedied, the nuisance has ceased to exist. The general reason of the trouble is that the plasterer,

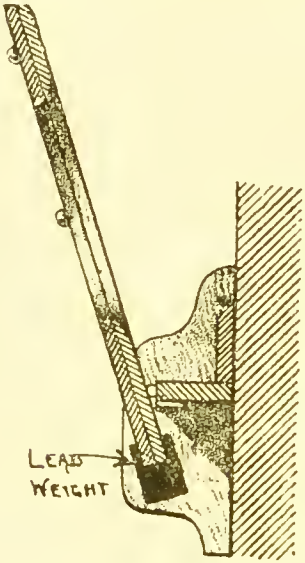


Fig. 55.

knowing that his work near the floor will be obscured by the wood skirting, as a rule skips that portion, and the joiner following, cuts away, plugs the walls, or does not continue this skirting inside the part to be framed in, and therefore, should the enclosure be battened, or merely timber partitions, any smells from the apparatus when in use and foul-

ness with which the floor, &c., is often saturated, or from defective joints will, ventilate up and around the hollows in the walls, and be conducted into the surrounding rooms.

The form of water-closet to be preferred is one so constructed as to give ready access to all its parts for cleansing, and to serve the three purposes of water-closet, urinal, and slop sink, thus for a certainty doing away with at least the last-named contrivance generally required in houses. It should be fitted with a balanced seat (Fig. 55) so that the inconvenience caused from the spilling of slops may be avoided, and which, when required, can readily be put into positon for use. The soil should be immediately immersed in a good volume and deep seal of water, and delivered directly into the drains without coming into contact with any exposed surfaces; there should be no sharp angles nor ridges which would collect filth or in any way interrupt the easy flow of the flush.

Some of the most sanitary forms of water-closet apparatus now in use are constructed on the wash-down principle, which provides the foregoing desiderata in a very satisfactory manner. The up-to-date pedestal valve closet (Fig. 56) might be placed one of the first on the list of sanitary closets, recent improvements having brought it to the front. This closet is made on the wash-down principle, but in order to retain a deeper seal of water in the trap, without giving rise to the soil and paper not clearing the basin, a valve is placed at the mouth of the trap, which opens upon the

handle being raised for flushing, and upon so doing the water seal is at once lowered to the ordinary depth of the trap, and when the valve is replaced is again heightened by being held above its level. The best of these closets are simple in construction, nearly as much so as any apparatus, there being no open spaces such as existed in the old forms between the valves and water in trap, for the

Fig. 56.

collection of foulness to be let loose into the house upon the valve being opened, nor is any extra ventilation required, owing to the valve being always below water level. The pedestal valve closet is especially adaptable for private houses and places where they are not subjected to rough usage, as the valve upon being damaged would not retain the extra amount of water required. There is also a likelihood, as in the plug closet, of

paper getting between the valve and basin, thus letting the water escape; but even then the closet is not rendered unsanitary, provision being made, as before said, for the ordinary height of water in the trap to cover the valve, so that it is always under water.

In most valve closets an overflow pipe is fitted near the top of the basin to prevent its running

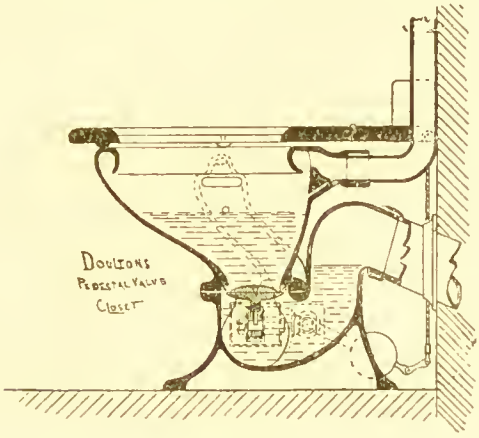


Fig. 56.

over in the event of the valve in the flushing cistern getting out of order and causing flooding in the closet. This flooding is an occurrence not likely to take place often, but it requires guarding against, and in a proper manner. Many closets have been ridiculously rendered unsanitary by the fixing of this pipe. It has been trapped and taken direct into the soil pipe, and, of course, there being little or no water to pass through it,

it becomes unsealed, and remains so to ventilate the drains into the house until discovered and rectified. It has also frequently been connected in the valve chamber, a box between the trap and valve, existing in most valve closets, and which

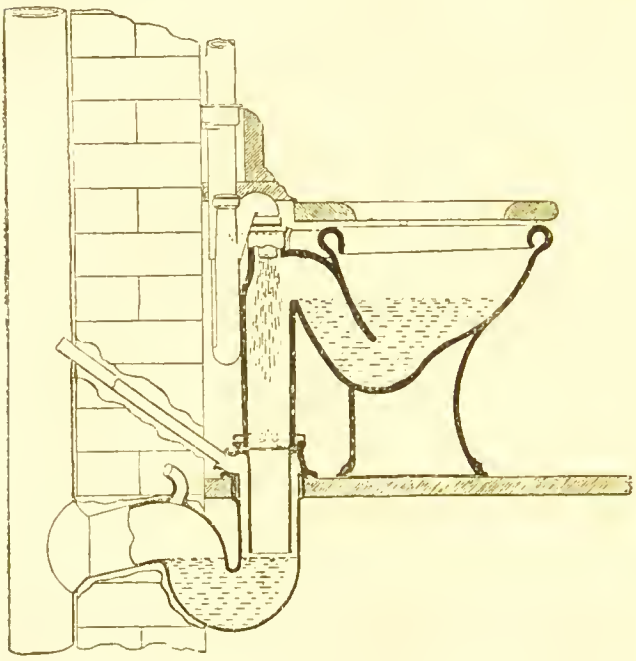


Fig. 57.

would convey the foulness of this chamber into the house. The pipe should be as short as possible, properly trapped, and connected with the outlet side of valve box, and the apparatus so constructed that the pipe and trap may be simultaneously

flushed with the closet basin by means of the flushing rim, as is the case in Jennings' "Era" and Dent and Hellyer's "Optimus." This arrangement equally applies to the pedestal valve closet, which should always be provided with an efficient overflow.

All pedestal closets should be provided with lead safes underneath, each having an inch waste pipe taken through wall into external air, with its end covered with a brass flap valve to prevent draught. Equally efficient to the valve closet, but of different construction, is the syphon action apparatus (Fig. 57). This closet is constructed with the best form of wash-down basin, its chief features being that the trap in connection with the basin is carried up higher than usual. This affords the advantage of the water standing higher in the basin, giving a safer seal than usual, and less exposed surfaces to become soiled, the water surface being sometimes 12 by 10, and the depth of seal in trap 4in.; but with the assistance of the syphon action occasioned by a second trap on the outgo, which sets up a vacuum upon the apparatus being flushed, the basin is enabled to properly clear itself of its contents. Several of these syphon closets (Jennings' Century) have been fitted in connection with the public lavatories at Margate, and also in the prisoners' cells in the Police Station, some having been subjected to unusually hard wear for four years, and up to the present are as good as new, and have given perfect satisfaction.

Next comes the ordinary wash-down closet

(Fig. 58), which, when properly shaped, gives good water surface, and with a sound flushing rim is an inexpensive and sanitary apparatus. This closet consists merely of a basin and trap, generally made in one piece, and so constructed that the soil is at once immersed in a good body of water, and upon being flushed is delivered directly into the soil pipe. A number of these forms of wash-down closets

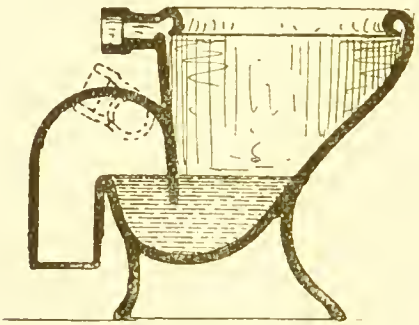


Fig. 58.

(Doulton's "Simplicitas") have been fixed under the author's supervision, and given great satisfaction.

All closets should be manufactured with proper flushing rims, which should cause the water to thoroughly wash clean the whole of the surface of the basin. The outlet pipes of closets should always be connected to the branch soil pipe above the floor, as in Fig. 58, so that the joint with the soil pipe branch may be properly seen and not hidden from view, as is the case in Fig. 54. It will be found best to use water-closets with half S.

traps (Fig. 56), when the apparatus is to be jointed with a soil pipe branch through a wall, as by so doing the joint remains in sight, and the outgo will form a good angle with the soil pipe. The S. traps (Fig. 58) should be used when connecting directly up with drains on ground floor. In cases where the water-closet trap and basin are in separate parts, the joint between the two should

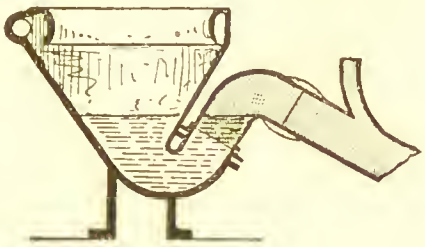
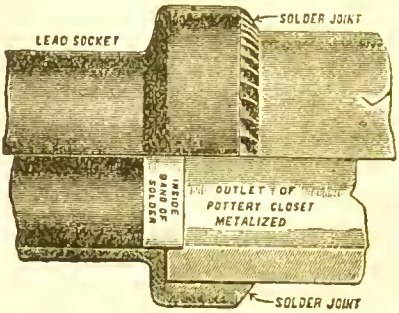


Fig. 59.

be made below the level of the water, so that should the joint become broken it will be discovered by the leakage.

The jointing of water-closets with the soil pipe branch is one of the works of house drainage most needful to be satisfactorily executed. Failing this, drain air for a certainty will enter the house through any defect in the joint, and perhaps continue for a considerable time without being discovered. Now that every facility is given to plumbers for making these connections with safety, the method too commonly practised of using red lead and putty bound round with cloth joints should be discarded. These joints

are a snare and a delusion, being most unreliable and in danger of breaking and opening at the slightest shake or settlement, nullifying at once all



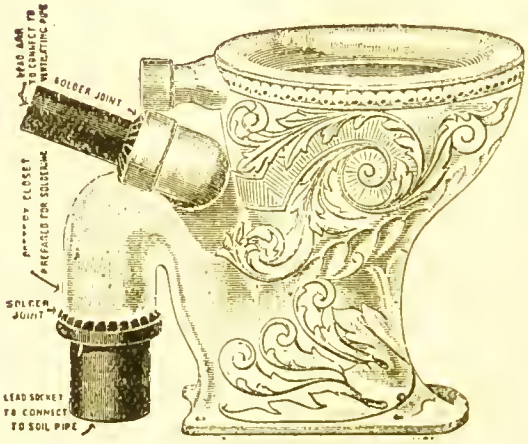
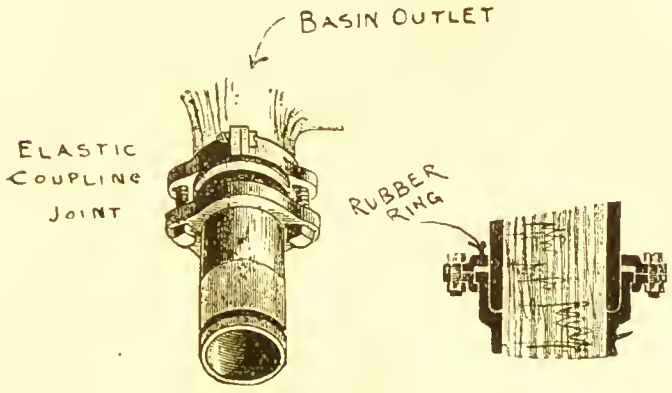


Fig. 60.

the care, trouble, and expense lavished on the whole house drainage system.

Some of the principal joints made for joining water-closets to soil pipes are executed in the

following manner:—Dent and Hellyer's closets are, as a rule, specially arranged to meet the difficulty of forming a proper joint. The outlet pipe of closet is of lead, flanged, and bolted to the water-closet trap below the water-line, so that if any leakage takes place it would immediately show itself (Fig. 59). This provision enables a proper



Figs. 61 and 62.

wiped joint being made between the lead outlet and soil pipe branch.

Doulton's patent Metallo Keramic joint (Fig. 60) is always adopted by the author with their closets, is a lead out-go pipe jointed to the earthenware—a joint which is perfectly secure and reliable, forming a first-rate connection with the soil pipe branch, the plumber merely having to make a wiped joint between the two. Jennings' elastic coupling and union joint, as illustrated (Figs. 61 and 62), ensures an air-

tight connection between the soil pipe and closet basin. Another connection on a similar principle

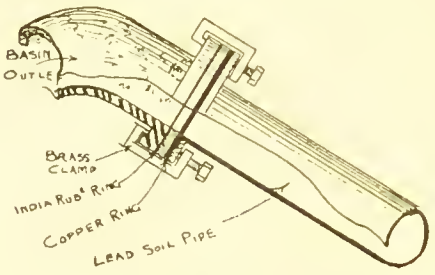


Fig. 63.

to the latter is the clamp and rubber-ring joint (Fig. 63). The brass socket and cement caulked

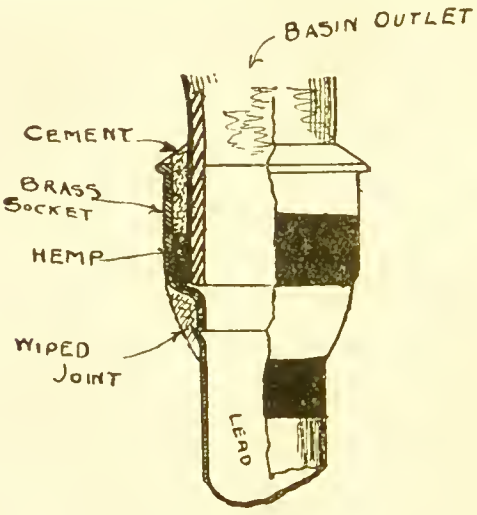


Fig. 64

joint (Fig. 64) is frequently used, and when properly executed renders a safe connection.

The action of frost on ordinary closets and flushing apparatus when in exposed positions is sometimes very destructive and injurious to their effectual working. Special provision should therefore be made to prevent freezing, and to do this where the pedestal closet and arrangements are

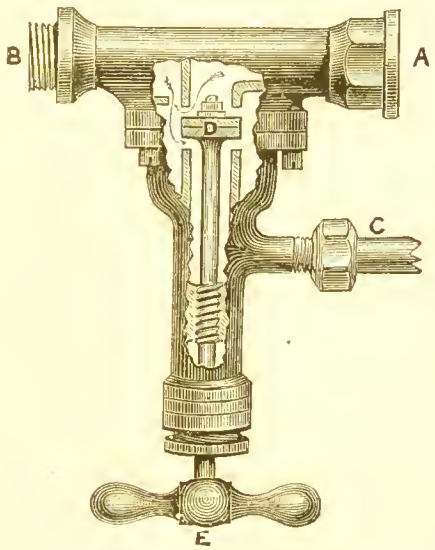


Fig. 65

used, they should, together with all waste pipes, be fixed on the least exposed wall, and the water-supply pipe provided with a frost tap, such as Simpson's patent (Fig. 65), so that the water may be turned off and drawn from the pipes during severe frosty weather when not required for use. The closet basin should also be provided with a cover which

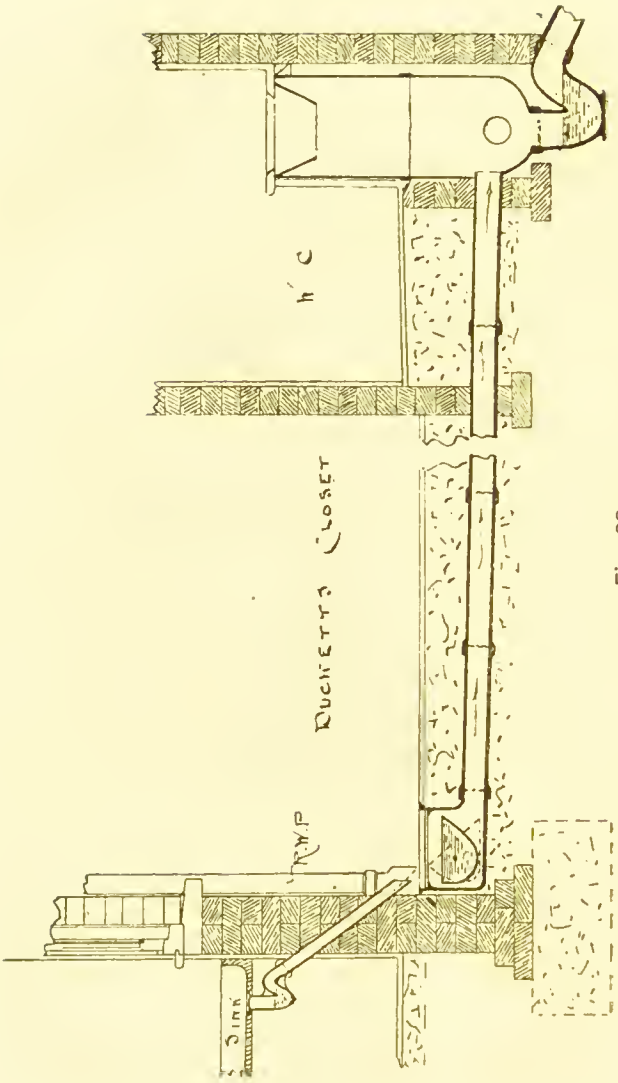


Fig. 66.

should be kept closed, and a small quantity of kitchen salt sprinkled with the water of basin will further prevent freezing.

Some excellent closet contrivances have been invented for cottages and other small properties. The slop-water closet, such as J. Duckett and Son's (Fig. 66), which is largely used, is so constructed that the soil is removed from the apparatus by the waste water from sinks, baths, and rain-water

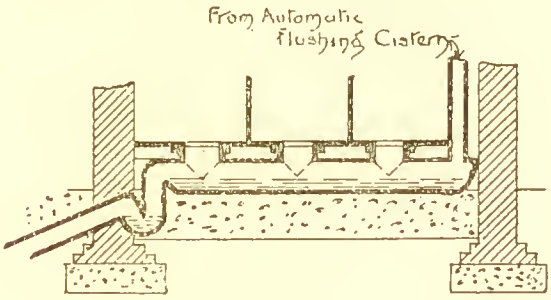
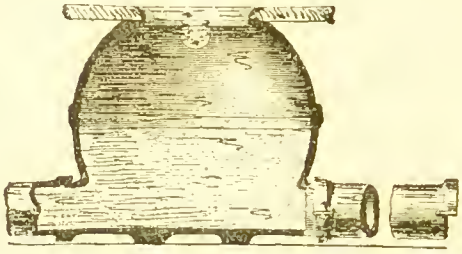


Fig. 67.

gullies, which is conveyed to a vessel or tank holding $3\frac{1}{2}$ gallons. This upon becoming full tips up or syphons out and automatically flushes the apparatus and drains, the former again regaining its upright position. These closets are not subject to defects through frost, and do not require the use of fresh water for flushing. Another apparatus specially adapted for factories, schools, and places where it may be subjected to rough usage is the trough closet. This consists of a stoneware or white porcelain enamelled iron continuous trough, provided with closet seats at intervals in separate com-

partments, thus forming several closets. The floor of this trough is made with a slight fall towards the outlet, where it is again raised to form a basin to contain water, beyond which is a trap similar in construction to other closets (Figs. 67 and 68). It is generally flushed by means of a tank cistern work-



JENNINGS SYPHONIC TROUGH CLOSET

Fig. 68.

ing automatically, or the foregoing tipping arrangement can be used.

Section 2.

Flushing Apparatus.

Having selected a good and reliable closet, its satisfactory working depends on the efficiency of the flushing apparatus provided. The use of unsuitable flushing apparatus is neither sanitary nor, in the long run, economical, most of the old flushing appliances being great water users with comparatively small results, whereas the flushing could be better done with less trouble and unneces-

sary waste of water by the use of more perfect systems.

There are numerous descriptions of good flushing apparatus for closets, but before considering these it is necessary to give examples of unsanitary methods in order to guard against them. In most instances where the supply is intermittent, houses

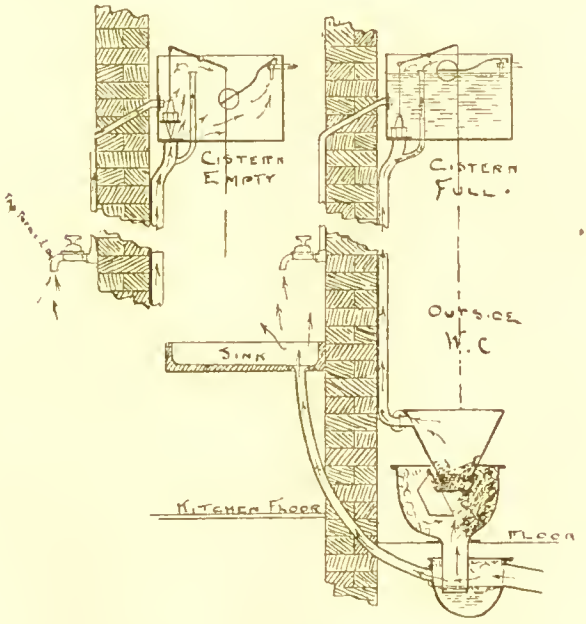


Fig. 69.

are provided with cisterns for storing the water for domestic and other purposes, and sometimes the closets are flushed direct from these cisterns, the result being that the supply may be contaminated with the impure air from the closets through the

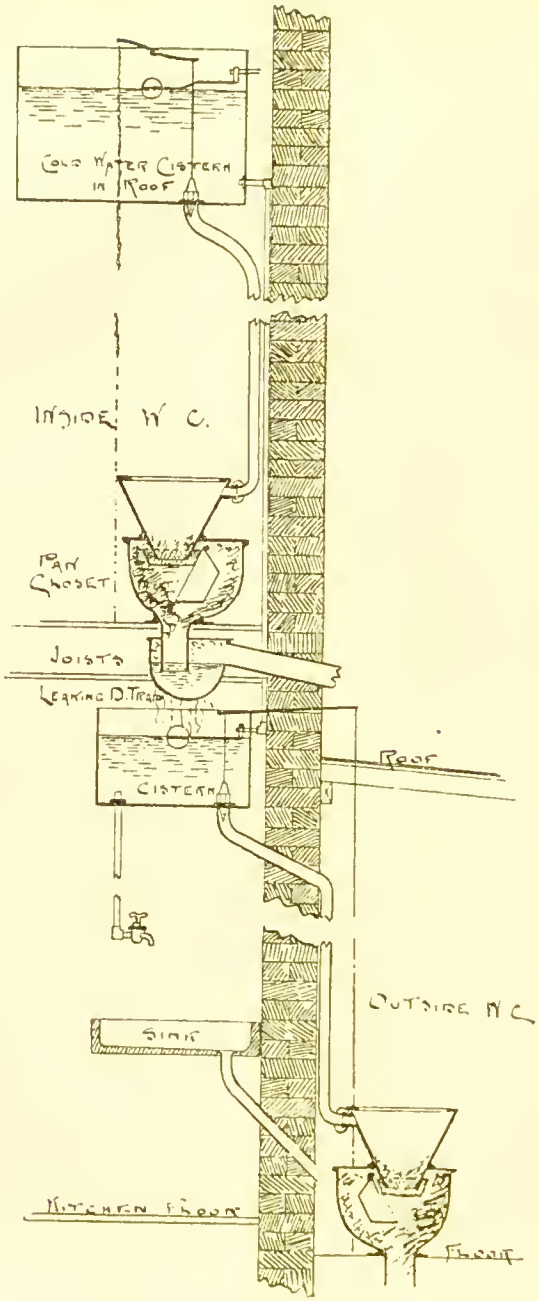
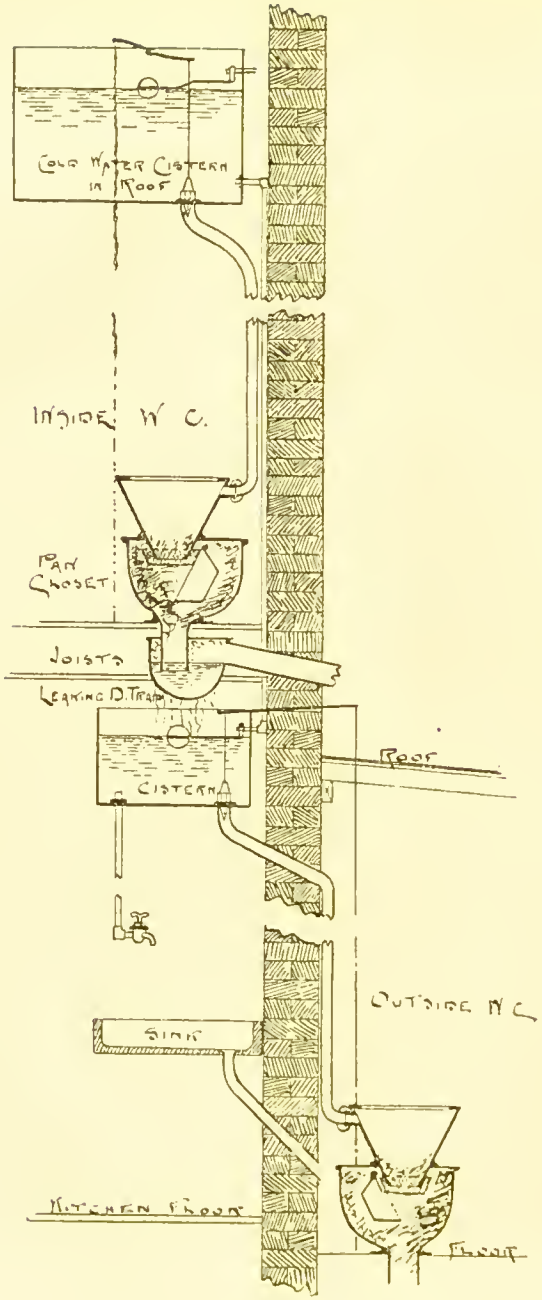

Cold Water Cistern in Roof
Inside W C.
Pan Closet
Joists
Leaking D. Trap
Cistern
Roof
Outside W C
Sink
Kitchen Floor
Floor

Fig. 70.

flush pipe or other intercommunication. Figures 69 and 70 illustrate some defects reproduced from the author's note-book. It is a matter of grave importance that no such direct connection should be allowed, although, without doubt, the number of houses in which such a dangerous defect exists would upon examination be found rather a large one.

Frequently the only flush to a water-closet is by turning on a tap on the water service (Fig. 71). This not only gives an insufficient flush, but is a great water waster, and a very dangerous contrivance for contaminating the water in the pipe or main, especially when the supply is intermittent, or at times when the mains are emptied by accident or otherwise, foul air, and possibly other matters, being sucked into the distribution system. No closet should be flushed off any arrangement in direct connection with the water supply of the house, but be provided with either proper flushing valves or separate flushing cisterns. Flushing valves are now nearly obsolete, and their working not always sanitary, their main faults being that in cases where the flush pipe is on the water service, should the pipes become empty by the water in the main being turned off for repairs, or through the supply being inconstant, the same disadvantages attach to them as to the turn-down tap.

Closets should be provided with syphon flushing cisterns, such as Jennings' (Fig. 72) or Jones and Brice's (Fig. 73), one for each closet, and fixed on the wall 5ft. or 6ft. above the floor on brackets


Cold Water Cistern in Roof
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These cisterns should then be supplied with water by a separate service, either from the main or storage system (Fig. 74). This cistern is connected with the closet by a lead flushing pipe, which should be carried direct from the cistern to the closet basin, and firmly jointed at each end in the best and strongest manner. It ought not to be less than 1½in. in internal diameter, and that size maintained from the outlet of the cistern to the flushing rim. By using this sized pipe it will be found that the large and quick flush thus provided will more effectively cleanse the basin and drains than a smaller and slower one would.

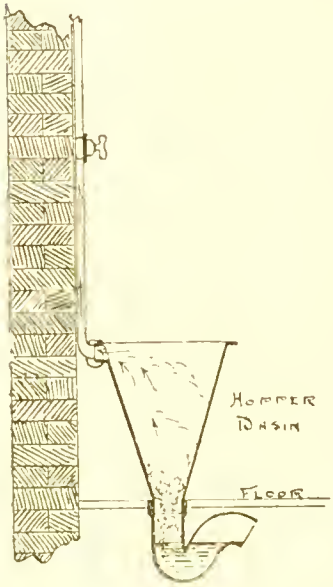


Fig. 71.

Syphon cisterns should not hold less than a two-gallon flush, to be discharged immediately on the handle being pulled, the whole being syphoned out in three seconds. A two-gallon flush is sufficient to cleanse most good closets and drains, where the soil pipe is 3½in. in diameter and the drain 4in. with good fall, but in cases where the drains are 6in. or more it is advantageous to use a three-gallon

flush, *i.e.*, if the water company will allow it. This again shows that now-a-days, when the economical

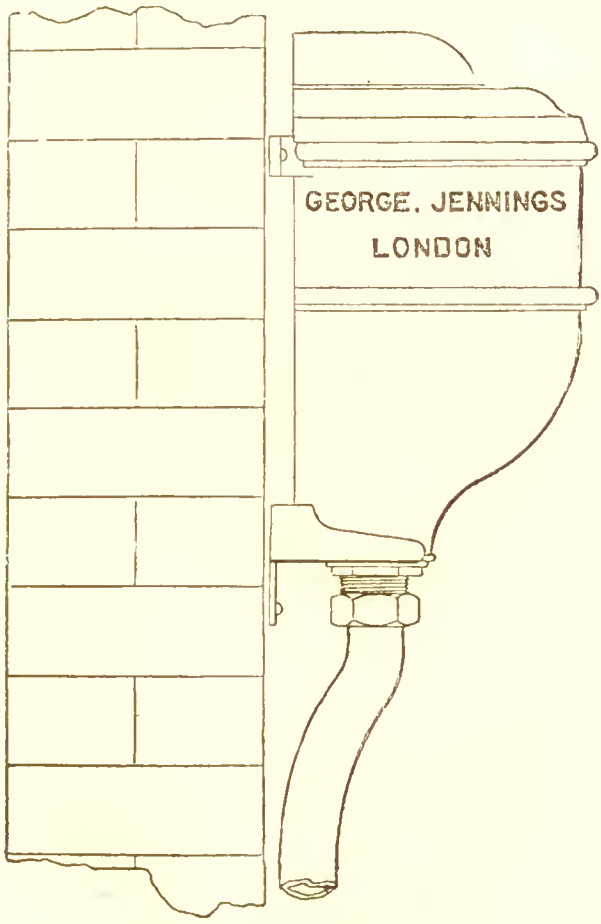


Fig. 72.

use of water is an important matter, the advantage should be taken of using 4in. drains for ordinary

sized houses, as requiring a less amount of water for effective flushing than larger sizes.

Automatic flushing tanks and cisterns, although not so much required in the majority of house drains, are invaluable when fixed at the head of lengths of drains, especially in cases where only a small fall can be obtained. These tanks are generally constructed on the syphon principle with

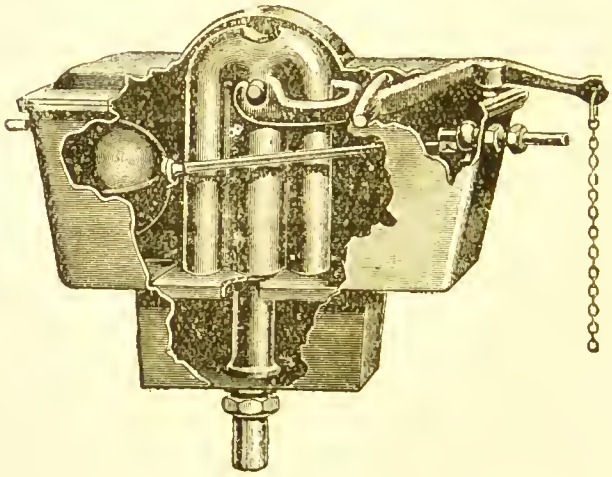


Fig. 73.

delivery of large bore so as to allow of their contents being emptied at once into the drain. They can either be supplied with water from the main or with waste water from baths, lavatories, sinks, and rain-water pipes, &c., which otherwise would generally dribble down the drain with little cleansing power. They can be obtained to hold from a small to a large amount, the general size

being about eighty gallons. The tip-over contrivance is also a good form of flush. That manufactured by Messrs. Braby and Co. (Fig. 75) has a tipper made in two compartments, so that when the principal or large one is discharging it is replaced by the smaller, which upon being filled

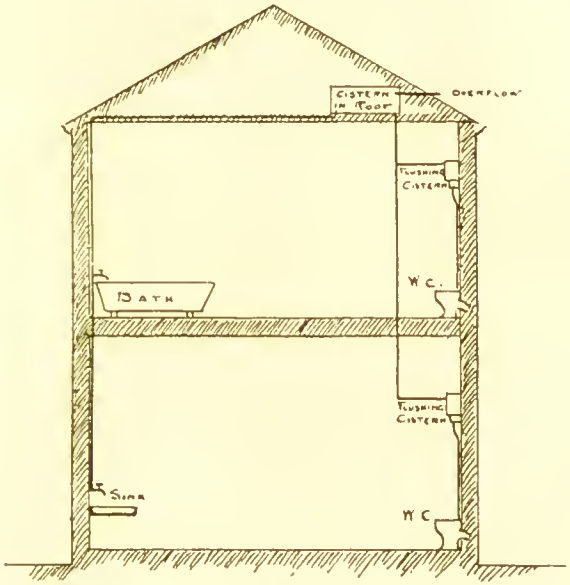


Fig. 74.

outweighs the larger vessel and tips back again, into position. The apparatus is enclosed in a brick chamber and made to discharge into the drain, being fed by the waste water which is conveyed to by a pipe, and tippers can be obtained to discharge any amount up to two hundred gallons of water at a time.

Trough closets and urinals should always be fitted with automatic flushing cisterns of a capacity suited to the number of stalls and length of the

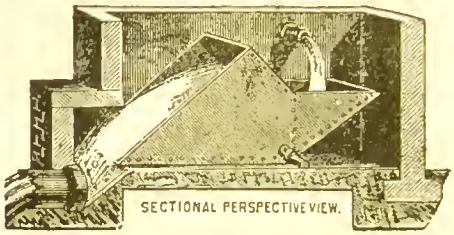


Fig. 75.

trough. The discharge can be regulated according to the requirements of the apparatus.

Section 3.—Sinks.

Although slop sinks (which are places where servants empty their pails) are convenient in large establishments their adoption in ordinary buildings where proper pedestal closets are provided may be dispensed with, as it is important that the number of inside connections with the house drains should be minimised as much as possible, water-closet basins being now specially manufactured with a slop top, but with a good size basin this slop top is scarcely necessary. Slop sinks consist of an earthenware or porcelain enamelled iron basin, about the same size as that of a water-closet, and fixed in an open framing of woodwork, and connected with a special pipe by a 2½in. waste and trap similar in every way to the closet apparatus, the out-go pipe being well ventilated by means of

a 2in. vent to prevent syphonage. In the top of the sink should be a slop top of the same ware also

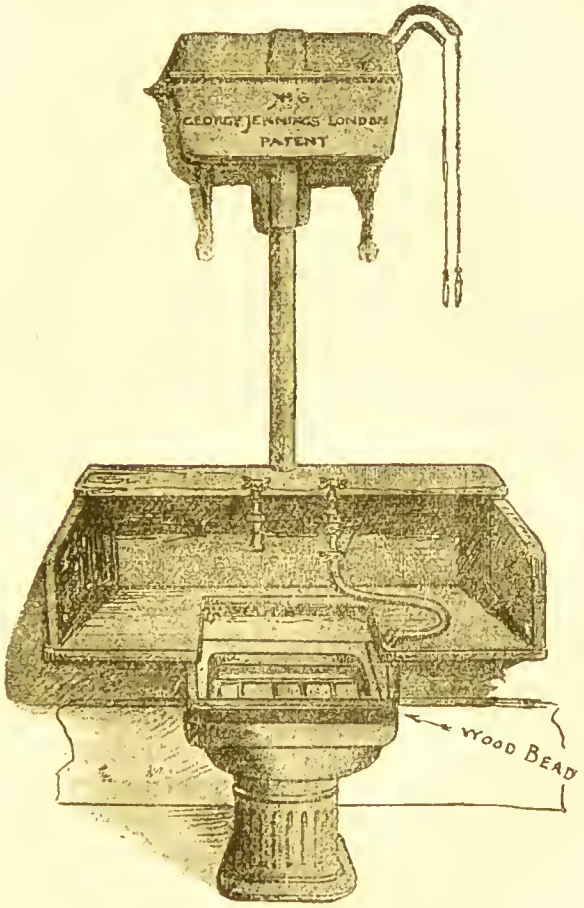


Fig 76.

forming a flushing rim, and both sink and top manufactured in one piece (Fig. 76). A fillet of wood

should be fixed in front of the sink to prevent pails coming into contact with the earthenware and breaking the apparatus. An enamelled iron grating is fixed at the bottom of the basin to prevent valuable or obstructive articles entering the drains. As in the case of closets, the inside surfaces should be washed by proper flushing apparatus, and a lead safe with waste pipe in 5 lb. lead should be provided under the sink in case of spilling or overflow. It is very important that these sinks should be placed in good sanitary positions, no other situation but against an external wall with proper window to open being admissible. The method of placing them in unventilated chambers or on confined landings is specially objectionable.

Scullery and other sinks should be made impermeable, and of cleanly material adapted for the purpose intended. The waste pipe should be fixed in either the right or left-hand back corner, and the sink fixed to give a fall from all parts towards that angle so that it will drain itself. The commonly used white glazed earthenware sink with ordinary care answers as well as any, but it has its disadvantages when the household crocker &c., comes in sharp contact with it. Wood is sometimes used as a protection for such utensils. Wood sinks lined with thick lead, or, better still, tinned copper, are recommended, and in some cases are to be preferred.

The white glazed earthenware sink is the best for washing vegetables and other articles of food in connection with the kitchen, the

material being non-poisonous and easily kept clean.

Sink waste pipes should be of lead 2in. in diameter, and trapped directly under the sink by means of a syphon trap provided with brass thumb-screw under, for cleansing purposes. The waste should be fixed by opening the inlet, and to ensure a fit with the outlet hole, the opened end being passed through the bottom, the pipe can be tafted over the inside of the sink, which is counter-

Fig. 77.

-sunk for that purpose. An ordinary brass grating can then, in the case of small sinks, be tafted over the waste. It is, however, necessary in the case of sinks required for washing-up purposes to adopt a brass cup grating, the cup being inserted in the opened end of the pipe in order that a plug may be used for retaining the water. In sinks of the latter description overflow pipes should either be provided in its manufacture, as in Fig. 77, or by means of a pipe connected with the waste on the house side of the trap.

Section 4.—Urinals.

The urinal is a most imperative necessity amongst sanitary fittings, and its extended use in hotels, schools, factories, and public conveniences has brought about great improvements in its construction. It is not an easy thing to contrive a sweet

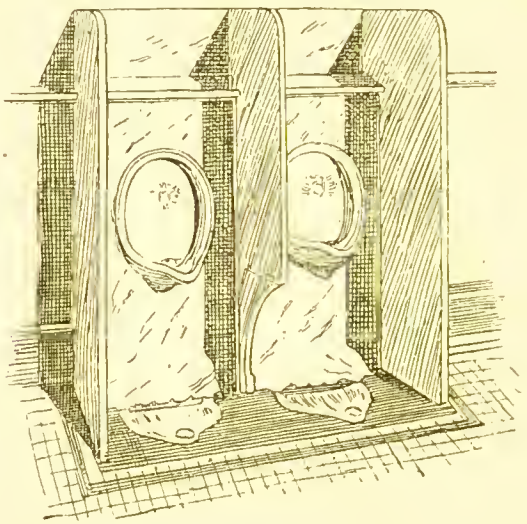


Fig. 73.

and cleanly urinal, and cheap ones are generally nasty. In all cases it is a matter of much consideration that the most sanitary form and serviceable value should be obtained. Urinals should be placed in well-lighted and ventilated positions, with due regard to convenience; if this rule is not kept in view, more or less, a nuisance is sure to result.

Urine is of a very corrosive nature, and will form a thick incrustation on the surfaces of an apparatus if at all neglected, even for a short period, which coating will throw off a strong and disgusting odour, besides sometimes corroding the small trap and pipe found in some makes, and these being forced by some inexperienced person, will often become damaged, and the trap rendered useless, leading to the escape of drain air. Urinals, therefore, should be arranged so that they can be automatically flushed at frequent intervals with fresh water, the apparatus being also cleansed down at least once every day, and all corrosion removed. This will be found a comparatively easy matter if regularly done; when in a bad condition the use of hydrochloric acid may be necessary.

The best urinals should have no rough surfaces, unnecessary corners and joints, or any unprotected ironwork, to come in contact with urine. It is better to have no ironwork whatever, the sparges, &c., being either of copper or brass. The chamber floors should be tiled, cemented, or paved with impervious material, with falls towards the channels in connection with the apparatus, the urinals, together with floors and surroundings, being self-draining and easily cleansed.

There are several good patterns of urinals now in use, the most general form being an earthenware basin, containing fresh water fixed in a screened stall (Fig. 78). The water in the basin being more or less frequently changed by flushing from automatic syphon cistern or by treadle con-

nected with a grating, which is stood upon by the person using the urinal, thus turning on the water for the time being.

In the case of the basin urinals with gratings, a proper impervious floor should be laid under the grating, with a channel leading to a gully trap, so that the whole can be properly flushed.

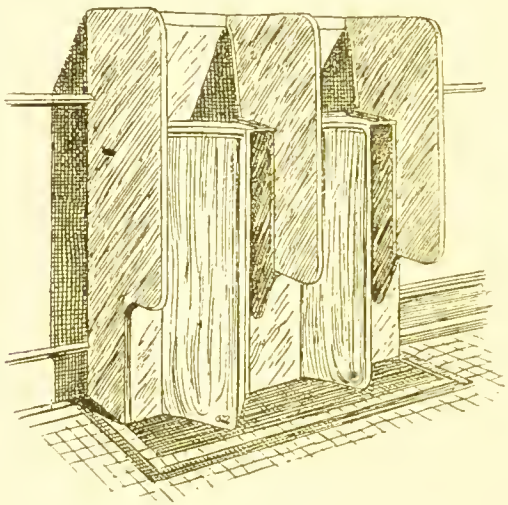


Fig. 79.

Some of the best forms of urinals now produced consist of stalls with cream or salt glazed ware semi-circular radials or bays, having floors of the same material, with falls towards a trap in front. The floor surrounding the urinal is laid with falls towards the same gully, so that every part can be sluiced down with fresh water, and the contents carried away down the drains (Fig. 79). These

urinals are very simple and strong in construction, and should have no joints or angles to collect filth, so that they can be kept effectually clean with a small amount of attention; the floors and backs should be manufactured in one piece, thus doing away with a joint between the two. A disinfecting block, suspended in the flushing cistern, has a beneficial effect. Hope's Pynerzone blocks and suspenders for this purpose give off a pleasant odour, and maintain the lavatory compartment sweet and

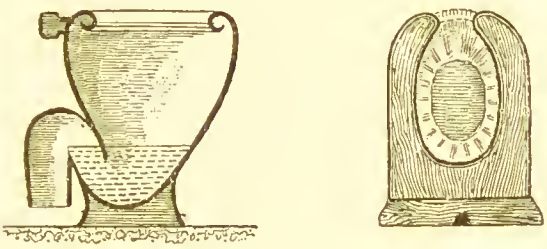


Fig. 80.

fresh. Urinal waste pipes should be trapped immediately after leaving the apparatus, and amply ventilated by a proper ventilation pipe and anti-syphonage before entering the drain.

A new and welcome departure in sanitary apparatus is the "Urinette" (Fig. 80). This contrivance is on the principle of a water-closet, but considerably smaller, thus requiring but little floor space; the object being its adoption in factories and such places where women are employed, and answers somewhat the same purpose as the urinal in the men's section. This apparatus is flushed in

a similar manner as the urinal by means of an automatic flushing cistern, and is so designed as to work effectually if used as a water-closet. Urinettes can be divided off separately, as in the case of trough closets, and each enclosure screened by means of a special hanging curtain, which may be drawn when in use and opened when vacant.

Section 5.

Baths and Lavatory Basins.

An essential and important factor in assuring and maintaining good health is personal cleanliness, which to every individual should be a habit of life. The neglect of the natural law by which the waste substances of the body are removed through the pores of the skin is that the perspiration instead of being freely removed is unduly thrown back on to the lungs and other organs, the result being that the system is lowered and rendered more liable to disease. It is therefore highly desirable that facilities for frequent ablutions should be provided in the dwelling-house. The excuse of want of room is hardly sufficient for its absence. The writer has seen in houses where the space has been exceedingly limited, baths conveniently fitted and framed with a mattress on the cover, thus serving a double duty as bed and bath.

The variety of baths now on the market are too numerous for their merits or demerits to be enlarged upon in the present article, but the following brief descriptions will give a fairly general idea

of them. Cast iron baths enamelled internally with roll edges and ornamental feet are simple in construction and of good appearance (Fig. 81). These baths do not require framing in. Some persons prefer a wooden to the roll iron edge as not striking so cold. These baths can be obtained with flanges arranged for an edging of woodwork being fitted to them. Copper baths are to be

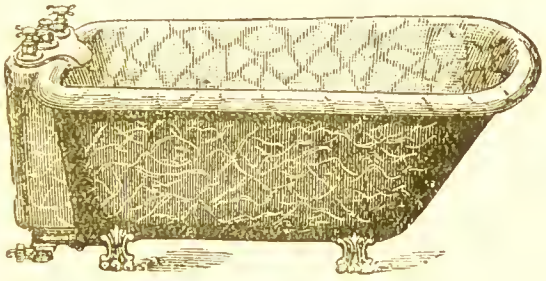


Fig. 81.

recommended in preference to iron, where they are much used, such as in hotels, schools, &c., as the latter under such circumstances, owing to the expansion and contraction, are liable to crack and become useless.

Some of the most cleanly baths manufactured, and particularly suitable for hospitals and public baths, &c., are constructed of thick earthenware glazed inside and outside, thus needing no framing in. This description of bath has a very inviting look in hot weather, whilst in the winter, when once warmed retains heat for a considerable time. Wood-framed and lead-lined baths are now

obsolete. Zinc baths are cheap, but not to be recommended.

All baths should be fixed against an external wall, and, as mentioned in Chapter IV. respecting sinks, the waste pipe should be properly trapped

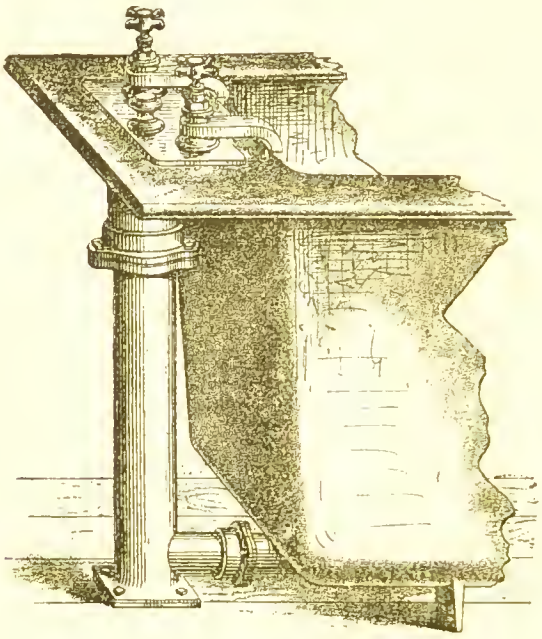


Fig. 82.

immediately beneath the apparatus, the pipe being arranged to discharge in the open air, either over a gully channel or connected with a special bath waste pipe carried up with an open end as a ventilator, and discharging under a gully trap grating at the foot. Overflow pipes should always

be fixed and connected to the bath waste pipe at the house side of the trap (Figs. 82 and 83).

When there is more than one connection a ventilation pipe must be carried off the waste pipes to prevent syphonage, such ventilator to be termin-

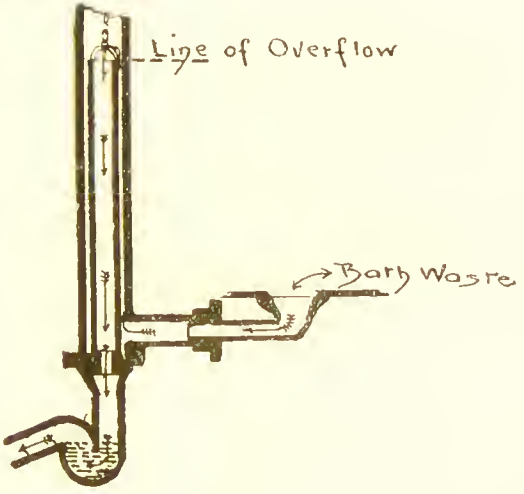


Fig. 83.

ated in the open air a short distance up the wall. The baths should also be provided with lead safes somewhat wider than the baths, with the usual waste pipe, its end being covered with a proper flap valve. The waste pipes from lavatory basins, also, should be treated in precisely a similar manner as those of baths.

Some of the forms of lavatory basins are as follows :—The plug basin is simply a glazed earthenware basin fitted with a plug and chain, having also

provision at the side to prevent overflow; these basins being inexpensive and lasting, are extensively used. The flushing rim basin is similar to the above as regards the plug, &c., but, in addition, is supplied with water through a flushing rim, so that the whole surface of the basin is well cleansed each time the water is turned on. The tip-up basins for lavatories are oval in shape, suspended in receivers (Fig. 84). They are clean and simple in

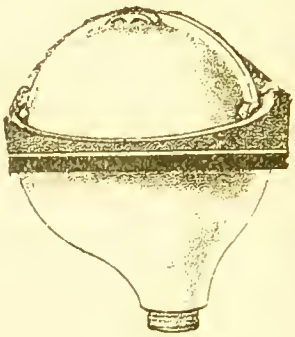


Fig. 84.

action, being especially adapted for clubs, hotels, and public lavatories. Twyford's "Rivulet" lavatory basins (Fig. 85) are supplied with a continuous flow of water, and designed for use in schools to obviate the possibility of a number of children washing in the same water, dirty water being carried away over a weir at the back of the basin into a waste pipe, whilst all sediment is removed into the same pipe through an outlet in the bottom of the basin.

Lavatory basins should be fitted in a slate or

marble top, supported by iron brackets or standards,

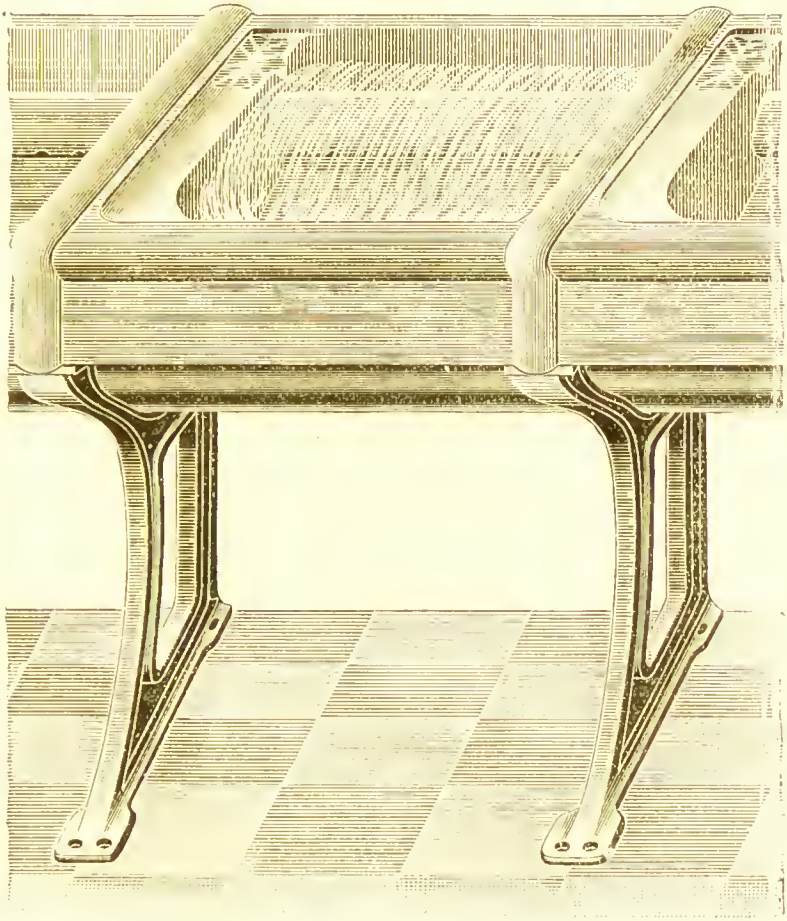


Fig. 85.

such top having a small bead at the edges to prevent splash water from running over on to the floor.

CHAPTER VII.

Drain Testing.

All drains should be specially tested before being covered in, to prove them as being gas and water-tight. The neglect of this important measure is sure to lead to trouble. It is requisite also that these tests should be extended to the soil and ventilation pipes, not only to ascertain if there are any defects in the jointing, but also in the case of the latter as to their due working, as they are liable from some unseen cause to a reverse action, the inlet and outlet having exchanged functions. It is imperative, therefore, that all drains upon completion should be carefully and exhaustively tested, so that their condition may be ascertained without doubt, and in the event of faults in construction or material they may be exposed and properly rectified.

With respect to drains which pass under or near to dwelling-houses, the best and safest one is the hydraulic or water test, which is applied in the following manner.—The lowest part of the drain is plugged by the insertion of an india-rubber expansion stopper, such as Jones' (Figs. 86 and 87); and after this has been done the drain is filled with water until it runs into one of the gully traps at the highest level. Should the drain be perfect, the water will remain for some time at this level without lowering; but if a leakage or weakness

exists, the water will either never reach this level, or, should it do so, will immediately begin to subside.

It is needful to remember that upon the drain being filled for the first time a certain quantity of water may be absorbed by the dry materials of the inspection chamber and pipe joints, &c., but the

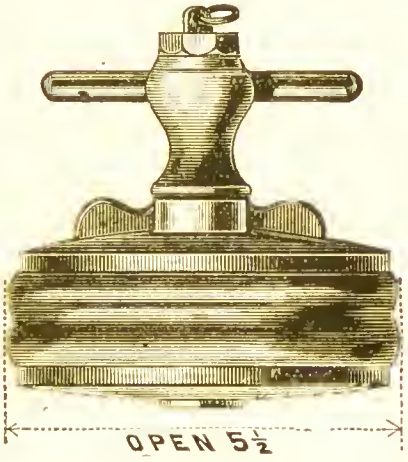


Fig. 86.

amount of water thus absorbed ought to be only a trifling quantity. Particular attention, however, should be paid to the external condition of the pipes and joints in order to detect any signs of sweating, this sweating proving that the pipes or joints are imperfect and unsuitable for their purpose.

In view of the severity of the water test, especially as regards drains with ordinary cemented

oints, these joints should always be permitted to set firmly before the test is applied, otherwise there is the likelihood of the cement being washed

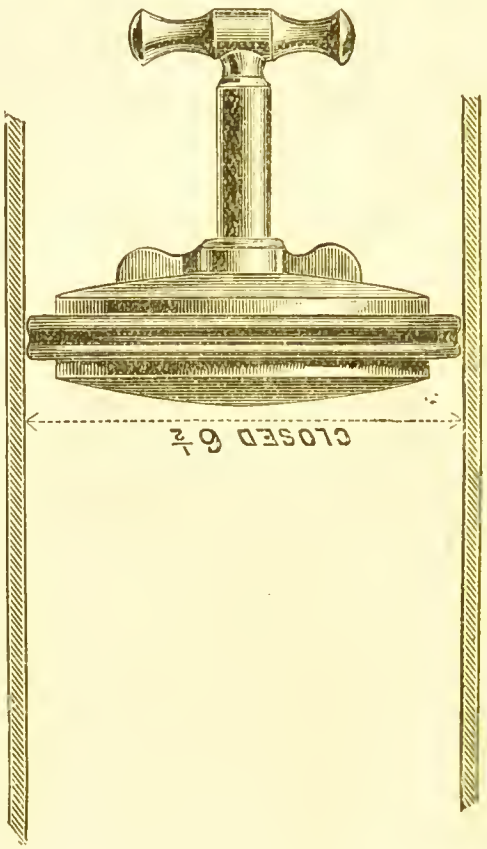


Fig. 87.

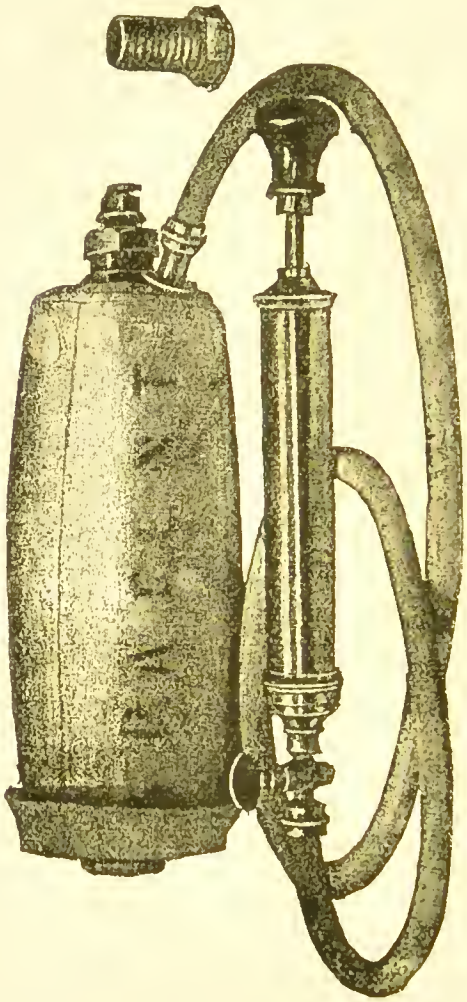
out of the joints or otherwise disturbed, which upon setting will render the drain defective. Ordinary socketed earthenware drains having a

fall of over 5ft. should be tested in sections. The advantage and necessity in such cases of using patent composite jointed stoneware pipes, or iron pipes caulked with lead, will thus be plainly seen, the joints of these being perfect in resisting high pressures, in some instances the pipes having given out before the joints. Soil pipes and ventilators should also be sufficiently substantial to stand the water test, and in the case of the former it is essential that they be so tested. This can be easily and conveniently done by plugging the end of the soil pipe and flushing the water-closet. Where there is a second floor of water-closets using the same soil pipe the lowest closets should be plugged by means of a Jones' patent air stopper (Figs. 88 and 89 on next two pages).

A quick and fairly efficient test, very useful in most cases, and particularly valuable for old drains, is the smoke test, as the smoke will sometimes rise through the ground in the event of the defects existing in the drains, thus locating the position of the fault. This test is highly useful for correctly ascertaining the working of the ventilation pipes, the character of which is immediately disclosed after the drain has been filled with smoke. In applying the smoke test the open ends of the ventilators must be first closed, and the smoke admitted in a manner which will confine it to the drain. Should there be defects in the drain, or insufficient water seals to the traps, the smoke will make its escape, it being, as a rule, easily detected.

Among the various descriptions of apparatus for

the purposes of producing and applying the smoke



Fi 88.

for this test are the "Eclipse" drain-testing

machine, the "Asphyxiator," Jones' patent,

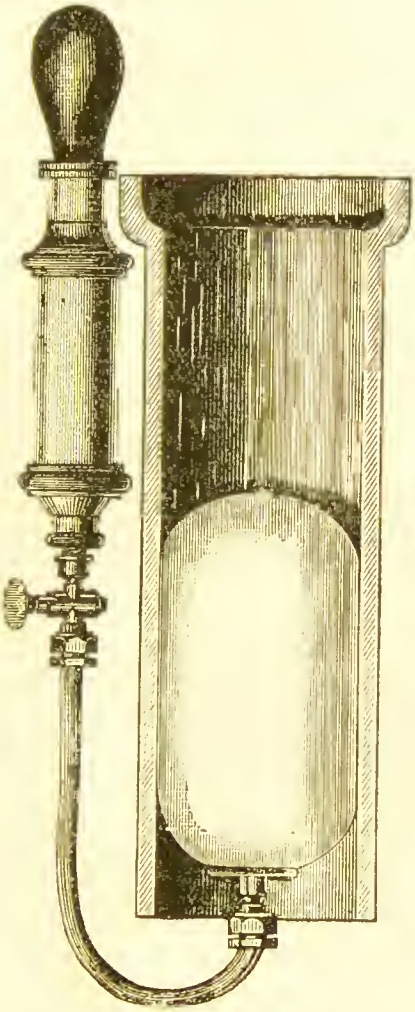


Fig. 89.

and the "Grahtryx," which are recommended for

general use. The former (Fig. 90) is made by Messrs. Burn Brothers, and consists of a copper chamber containing the smoke-producing substance. Communicating with this chamber is a double-action bellows, by means of which the smoke is propelled and generated. An advantage in the use of this apparatus is that upon the tube of the chamber being applied to the drain, and all vents closed, should the cover of the

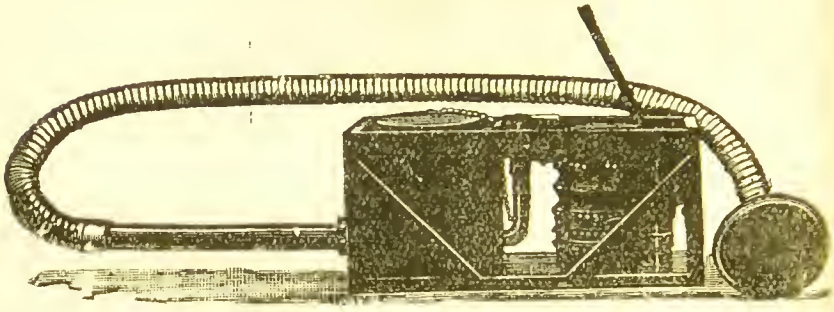


Fig. 90.

chamber which is water sealed while the machine is actuated, become raised, and remain so, it will prove that the drain is air-tight.

The "Asphyxiator" (Fig. 91), made by Messrs. J. Watts and Co., consists of a combustion chamber containing the smoke-producing substance. This substance is kept alight, and the smoke therefrom discharged into the drain through a flexible tube, by means of a revolving fan worked by a handle.

Jones' patent rotary-action smoke-generating machine (Fig. 92) is another good and compact

tester, and is worked somewhat in the same manner as the "Asphyxiator," but is a later invention, the tubes being made with unions to fit Jones' patent drain stoppers.

The "Grahtryx" smoke machine is also an

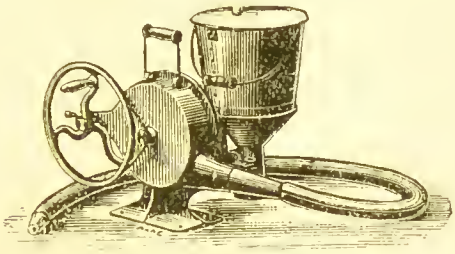


Fig. 91.

efficient tester. One of the best and strongest smelling substances used in the combustion chambers of smoke-testing machines is lighted oily engine waste or a mixture of sulphur and shavings. Smoke rockets (Fig. 94) such as Brock

Fig. 94.

and Co.'s, Pain's, or Burnett's, which upon being lighted throw off thick volumes of sulphurous fumes, are very useful and handy as drain testers.

After stopping up the vent pipes, three or four of these rockets should be placed in the lowest part of the drain, the fuse part foremost, and

properly lighted, a stopper being immediately inserted in the opening in the drain.

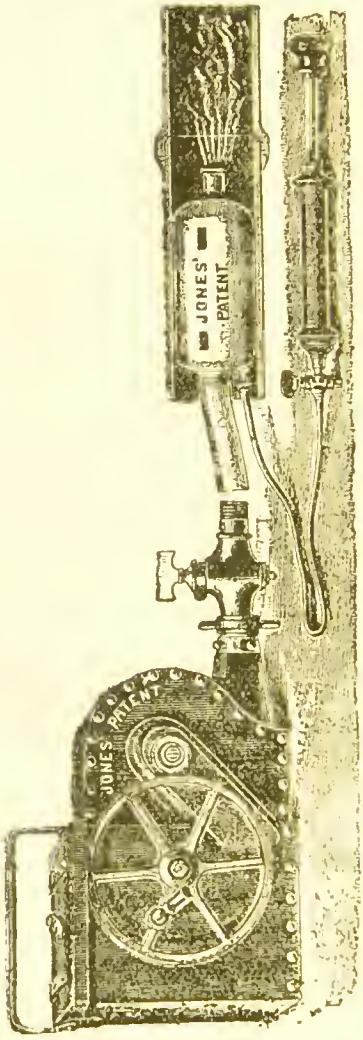


Fig. 92.

Where the ordinary air inlet boxes are attached to drains the rockets can be lowered down the inlet pipe by a piece of cord, and when they have finished burning the stopper and rocket cases can be removed, and two buckets full of water discharged quickly down the pipe, which will drive the smoke through the drains. It is often necessary in using smoke rockets to open the outlet and

Fig. 95.

Fig. 96.

inlet pipes for a short time to admit air before the smoke will pass through the drains.

Burnett's patent smoke tester (Fig. 95) is a satisfactory and convenient arrangement, it being on the same principle as the rocket, but can be inserted into the drain through the water of either a gully or water-closet trap. This is done with the assistance of a detachable wire handle, by which, upon the match being properly ignited, the tester is thrust through the water and the drain charged with a large volume of dark pungent smoke.

Smell tests for drains are sometimes used, more especially for testing the soundness of water-closets and other internal connections. The best for this purpose are chemical ones, the substance

being packed ready for use in small air-tight tin spring boxes bound round with a long length of string (Fig. 96). The string upon being partly unwound and the end held, the tin box is placed in the trap and flushed into the drains, warm water being best for this purpose, which will unwind the remaining string, whereupon the contents of the box escapes into the drain, and throws off a very powerful and peculiar odour, which soon finds its way through any leaky joints or fractures and is easily detected. Some of the best of these are Kingzett's and the Sanitas Company's Improved, Burnett's patent, and Kemp's patent, all of which the writer finds to act very successfully

Section 2.—Drain Cleansing.

Having in the foregoing articles given a general description of the work appertaining to house drainage, a few details with regard to their maintenance in a clean and sanitary condition will perhaps be useful. Although this operation seems an easy matter, especially where the drains have been carefully executed, yet in very few cases do the drains, when once carried out, receive that amount of attention at the hands of occupiers as is requisite for their maintenance in a cleanly condition. It is further an astonishing fact, that in hotels and factories it is far from an uncommon occurrence to find the drain literally choked with foreign substances, particularly so in the former. The writer has had instances where complaints have been made of drain stoppage, and which

upon investigation have been found choked full of pea pods and other such articles, which had been thoughtlessly disposed out of sight down the nearest inspection chamber. It is also a frequent occurrence to find the drains of hotels blocked with fat, especially where the cook has no personal interest in saving such matters.

There is again the frequently complained of gully trap, which is used year after year without attention, till a nuisance is created, and the Sanitary Inspector is summoned to search for the offender, and finds perhaps the gullies choked with filth, and of little or no use as a seal against the escape of drain air. A neglected grease trap is also a constant source of nuisance, and will sometimes throw off most disgusting odours.

The sink waste syphon sometimes becomes stopped, and this instead of being gently cleared by removing the thumb screw provided for that purpose, is more often ineffectually forced by some inexperienced person. The water-closet and such appliances require occasional attention, to remove the incrustation that forms in the trap, &c., otherwise a fœtid odour will be inseparable to them. Cisterns used to hold water for drinking and domestic purposes require to be regularly emptied and cleansed, which rule also applies to rain-water tanks, especially as the latter are often situate under ground and sometimes under the floor. The writer only recently investigated the case of an old tank, wherein, amongst other things, three rats

were found; in another instance several dead birds were found in a cistern in the roof.

Ventilation pipes should be periodically examined, and any rust or scaling that might have lodged at the bend, or birds' nests, removed. There are also occasional articles, such as nail and tooth brushes, combs, pumice stone, and like obstructions, which gain access to the drains, and become lodged in the traps, &c., and if not removed will soon cause trouble. The insufficient flushing of drains, resulting from cisterns being out of order, is likely to cause them to become choked, and also to event in a dangerous nuisance, which cannot be too carefully guarded against.

As was explained in Chapter V., one of the principal aims in construction of house drains should be to give inspection facilities to the whole system, so that, in the event of obstruction, ready access could be given for the speedy detection and removal of the cause, without disturbing or damaging the soundness of the work.

Numerous appliances are used for clearing and cleansing purposes, the principal of these articles being as follows:—Drains cannot be effectually unstopped and cleansed without the aid of clearing rods, a set of which should be in the possession of every large establishment. They consist of short malacca canes, and are jointed together for use by means of brass male and female screw connections. They are usually 3ft. in length, and are strapped together in convenient bundles of from ten to thirty-three rods. There are a number of fittings

used with these drain rods for various purposes; one of the most useful being the double-worm screw and guide wheel (Fig. 97). By its use such obstructive articles as rags, dishcloths,

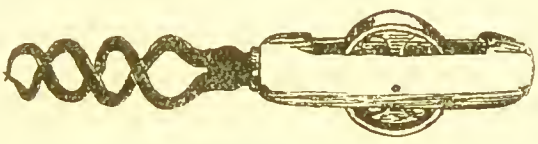


Fig. 97.

and paper can be removed. The double-spiral screw is particularly handy in unstopping intercepting traps from the air shaft. Some other useful accessories are the jointed scraper, which is employed for raking purposes. The spring hook which, being chisel shape, is for breaking through accumulations of solid obstructions in drains. The

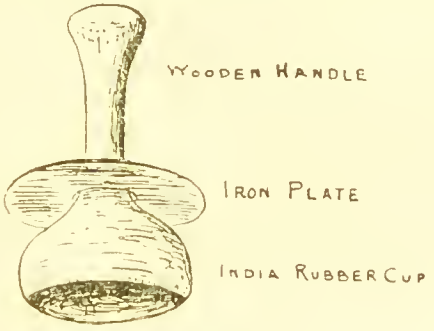


Fig. 98.

rubber plunger is for forcing choked drains, but this work needs to be carefully done, as there is a danger of pressing the obstruction tighter into the drain. The brass guide wheel is used to conduct

the rods round corners, and the whalebone or bass brush with guide wheel is used for sweeping and cleansing drains.

There are also several other articles for cleansing purposes; the closet brush is for removing any incrustation from the basin and trap; the gully ladle for removing filth from gully traps; and the sink force cup (Fig. 98) being amongst the most useful.

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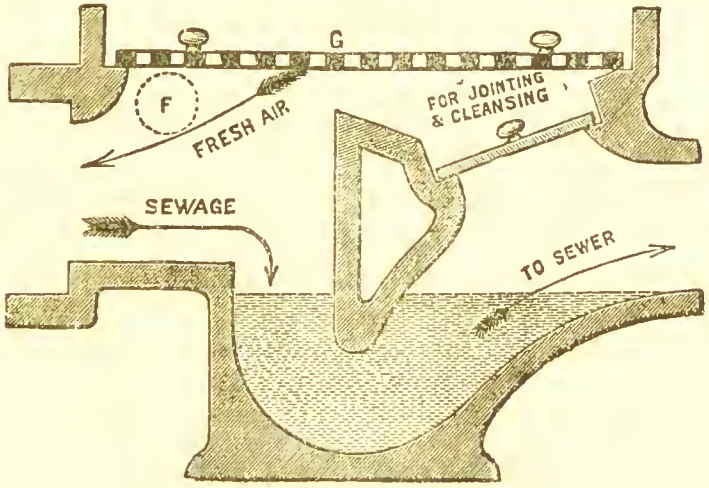

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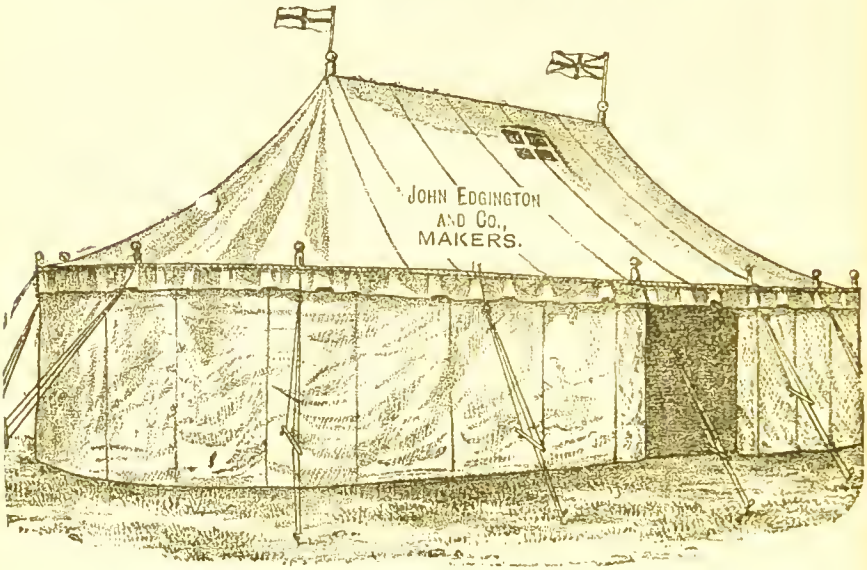

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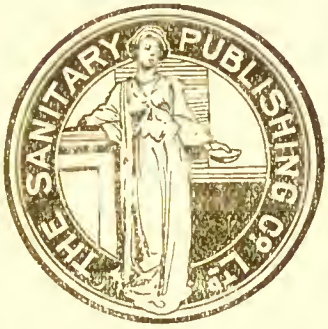

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